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PROCEEDINGS of the Tactical Nuclear Weapons SYMPOSIUM (U)

SCANNED AUG 05 1998

Signet

held at

LOS ALAMOS SCIENTIFIC LABORATORY
of the University of California
Los Alamos, New Mexico

September 3-5, 1969

Sponsored Jointly by
UNITED STATES ATOMIC ENERGY COMMISSION
and
DEPARTMENT OF DEFENSE

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LA-4350-MS

PROCEEDINGS OF THE TACTICAL NUCLEAR WEAPONS SYMPOSIUM (U)

Held at
Los Alamos Scientific Laboratory
of the University of California
Los Alamos, New Mexico

September 3-5, 1969

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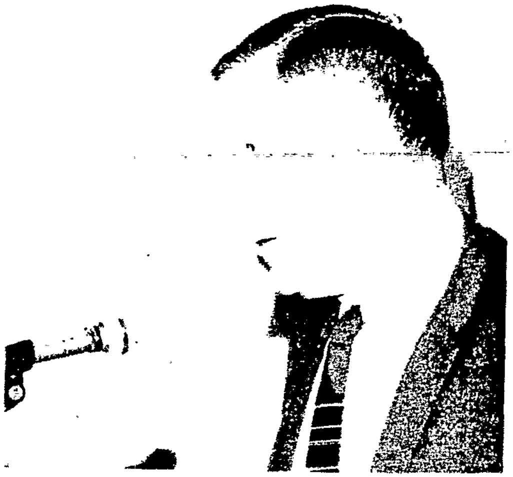
Harold M. Agnew
Los Alamos Scientific Laboratory



FOREWORD

It has been felt for several years that the potential role of tactical nuclear weapons has not received the attention it deserves in formulating our nation's defense capabilities.

Criticisms of our present capabilities have ranged from having too many weapons to too few, from having too large yields to too small, from having imprecise employment doctrine to too well defined, from having inadequate command and control procedures to having too restrictive procedures, and from being too concerned with possible collateral damage to ignoring collateral damage. In addition, the political credibility of tactical nuclear weapons has been challenged as a result of our emphasis on the importance of a conventional response, especially in Europe. These and many other factors have pointed to the necessity of attempting to have a frank discussion of the political, technical, and military aspects of tactical nuclear weapon systems. This symposium, which was requested by DDR&E, primarily addressed the military and technical aspects of tactical nuclear weapons. However, certain important political realities were also discussed. This was especially true during the question periods and in the summary session. These proceedings should serve as a basis for further discussions and planning in this field and perhaps suggest that, before another tactical symposium is held, a symposium on strategic weapons be held. Following that, a symposium covering tactical and strategic weapons and their interdependence might be profitable.

I wish to express my sincere appreciation to those who appeared on the program, to those who handled the logistics for the symposium, and to those who spent their time in attendance participating as a stimulating audience.

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ATTENDANCE 391

Maj. Gen. Edward B. Giller,
USAF
Division of Military Application

WELCOME

Ladies and Gentlemen, it is a pleasure on behalf of Chairman Seaborg and the Commissioners of the Atomic Energy Commission (also, I'll pinch-hit for the Department of Defense—I wear two hats, I suppose, in a sense) to welcome you to this joint AEC-DOD meeting. Dr. Bradbury, Director of Los Alamos, is not with us today. He is working very hard at Woods Hole, studying some problem for the Navy, and he asked me to fill in for him. Also, because DMA is non-partisan, I have to remind you that there is a "Brand X" laboratory on the west coast which is also represented today, Livermore Laboratory. As Dr. Agnew has pointed out, we certainly have a distinguished star-studded audience in and out of uniform today, and we are very happy to see so many visitors from overseas.

Especially in the field of tactical weapons one feels that the actual conditions pertaining in the field are not always taken into account in some of the "decision-making machinery" that deals more with specific hardware characteristics. This large audience indicates either a renewed interest in tactical nuclear weapons or interest in New Mexico's weather at this time of the year.

As you all know, the AEC has worked a long time on tactical nuclear ideas. Both laboratories have sponsored various forms of them, various specialities that are known to many of you, but in the last few years the interest has been mostly verbal. Only recently has there been an apparent change of heart or interest in tactical nuclear weapons. This means Phase 3 to us—namely, "putting your money where your mouth was." This has taken two forms in the last six months. Each year, in the first part of the year, January or February, AEC gets from the DOD something called development guidance—our marching orders about where to spend our money and where to direct our efforts. In spite of rumors to the contrary, the weapons program has limited resources for its development, and therefore we must work and should work on things which are important to the Department of Defense.

This last development guidance is quite different from that of the previous years. It shows much stronger interest in tactical nuclear weapons. In fact, there are four Priority I's (their highest priority) in the general purpose warfare section. In the previous year I don't believe there was a single item in Category I. As you all know, Phase 3 has been approved for Condor and Walleye—a full version of Condor and a limited version of Walleye. We have sent the Phase 2 study, which is the AEC final offer, if you like, trying to outline the characteristics and the price and cost of building. We have sent the final Phase 2 to the Department of Defense on the 155 mm and the 8-inch. My "spies" tell me that it is currently very hot over in the Department of Defense, and we are expecting perhaps a Phase 3 order on either or both of these in the next few months. We have not sent a Phase 2 on the ADM demolition munition. It is a much more complicated series of devices, and the decision machinery on that, I think, will be a lot tougher.

As I pointed out, this advanced development guidance we get is a document from which we take our instructions; it contains sections on strategic offense, strategic defense, general purpose, and also you might say a miscellaneous section on special effects and special purpose. It is much more than we can work on.

I have been in DMA for a couple of years now, and have come to recognize certain difficulties in trying to convert ideas to production line. Although one can usually settle the questions of yield, shape, weight, and size in a fairly straightforward manner, there is still insufficient dialog between the AEC and the DOD concerning some of the peripheral equipment. Peripheral equipment includes use equipment, packaging, permissive action links (a subject in themselves), and equipment involved in command and control aspects, especially for tactical devices, which are handled more by people than the strategic devices.

The AEC has studied some ideas about command and control—a touchy subject to the Department of Defense, I know—and you will hear about some of them in the next few days. I do urge the Department of Defense folks to think about how to use these things, separating that from whether you think they are needed; because if we have to put them in, a lot of thought in advance will save a lot of retrofit, pain, and trouble in using them. I do hope our speakers from the Department of Defense will try to bring out this aspect rather than the physical characteristics of nuts, bolts, weights, and shapes.

One last item dealing with production. As you all know, AEC also produces these devices, and we have a very large production system. It is an eight-plant system which is government owned, contractor operated. It has a fixed overhead of about between 150 and 200 million a year, that is, provided you are going to leave a plant at its present size. Then the incremental build, that is, the number of weapons you build above that in direct cost, is not significant in terms of the base cost, and if we are able to adjust our work load in the production system to the capacity of the system, we can produce a large number of tactical weapons especially, because they are not as complicated as some of the others for production purposes. We can adjust the build rates to our production rates. We can modernize the nuclear stockpile at a minor incremental cost to the AEC's budget, although I must admit from previewing the '70 budget and the '71 budget, even small incremental costs are going to be painful to come by because of the tight budget situation.

~~SECRET/RD~~

John A. Ord
Deputy for Technical Operations
U. S. Army Foreign Scientific
and Technical Center

SOVIET AND COMMUNIST CHINESE TACTICAL NUCLEAR CAPABILITIES

The overall classification of this briefing is SECRET/RESTRICTED DATA (see Figure 1).

Continued emphasis in Soviet literature and the nature of Warsaw Pact war games indicate that the Soviets place great importance on the role of nuclear weapons in tactical operations.

DELETED

DoE 1.4(c)

TACTICAL NUCLEAR WEAPONS SYMPOSIUM

September 3, 1969

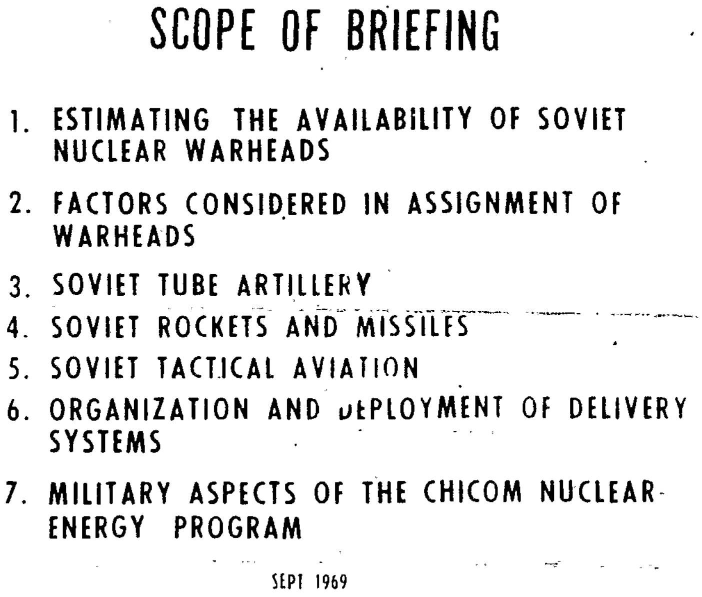
Soviet and Chicom
Tactical Nuclear
Capability

Prepared Under the Direction of the Assistant Chief of Staff for Intelligence
Briefer — Dr. John A. Ord

Figure 1

[redacted]

Accordingly, my briefing will cover the techniques employed in estimating the choice of warheads available to the Soviets, and the factors considered in assigning these warheads to delivery systems (see Figure 2). I will then discuss the delivery systems available to the Soviets, including tube artillery, rockets and missiles, and tactical aviation; and will discuss, where possible, the organization and deployment of these systems in the field. I will conclude with a brief assessment of the military aspects of the Communist Chinese nuclear energy program.



SCOPE OF BRIEFING

1. ESTIMATING THE AVAILABILITY OF SOVIET NUCLEAR WARHEADS
2. FACTORS CONSIDERED IN ASSIGNMENT OF WARHEADS
3. SOVIET TUBE ARTILLERY
4. SOVIET ROCKETS AND MISSILES
5. SOVIET TACTICAL AVIATION
6. ORGANIZATION AND DEPLOYMENT OF DELIVERY SYSTEMS
7. MILITARY ASPECTS OF THE CHICOM NUCLEAR ENERGY PROGRAM

SEPT 1969

Figure 2

The choice of warheads available within the Soviet stockpile has been agreed upon by the Intelligence Community from analysis of the Soviet testing program. [1]

DELETED

DOE
1.4C

These limitations, however, will constitute an intelligence gap in assessing their nuclear arsenal of the future.

In estimating the nuclear yield of a delivery system, we first consider the nuclear warheads believed to be in the Soviet arsenal. Then we analyze the estimated priority, characteristics, and application of each delivery system to determine the requirement and capability for nuclear warheads.

Nuclear weapon yields are then assigned to the individual delivery systems giving consideration to the following factors:[3]

a. What yields are desired for a given system?

b. How do the physical dimensions of the system affect this choice?

c. Will their estimated nuclear technology support such a warhead?

d. Is the fissionable material available?

e. Is the choice considered likely from knowledge of their weapons system chronology?

The Soviets may have nuclear tube artillery in their inventory, as the development of such weapons would be a logical extension of more conventional systems to meet modern military requirements.[4]

There is no evidence, however, that the Soviets have developed small diameter devices, even though it is estimated to be within their technical capability, and we have no indication of a nuclear round for the 152 mm gun-howitzer, their direct support divisional weapon.[5] (See Figure 3.) They likewise possess the technology to develop nuclear devices with fractional and low kiloton yields for their 203 mm gun-howitzer, but there is no evidence of their existence either. Two large-bore artillery pieces of 310 mm and 420 mm diameter should also be considered as nuclear capable systems, and suitable devices could be postulated for them based on the Soviet nuclear test program; however, they were produced in very limited numbers, and never adopted as standard.[6]

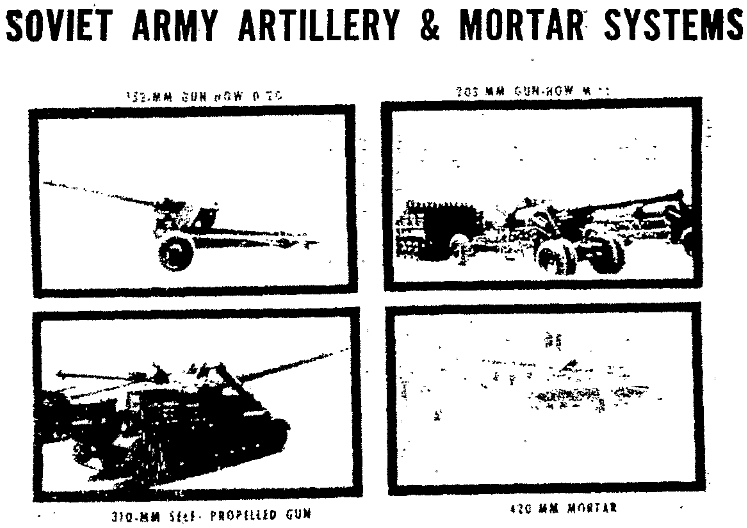

SOVIET ARMY ARTILLERY & MORTAR SYSTEMS
152-MM GUN HOW D 20
203 MM GUN-HOW M
310-MM SELF-PROPELLED GUN
420 MM MORTAR

Figure 3

The Free-Rocket-Over-Ground, or FROG (see Figure 4), is the Soviets' organic divisional nuclear fire support weapon. They consider the FROG a weapon for mass destruction of enemy troops and materiel in all phases of ground combat. Flexibility is ensured by its capability for rapid deployment and by its variety of warheads. A fundamental principle of the combat use of the FROG system is the surprise delivery of nuclear strikes against accurately located targets in accordance with the tactical situation and operational plan. The FROG weapons are included in the Army fire plans for massed nuclear strikes.

Since 1957, seven versions of the FROG have been sighted. The FROG-1 and -2 are no longer in their inventory. The FROG-3, -4, and -5 systems are identical in appearance except for their warheads, and have ranges of 36, 60, and 61 km, respectively. Of these three, only two have been widely deployed--FROG-3 with a diameter of 535 mm, and FROG-5 with a diameter of 400 mm.

DOE 6.2(a)

DELETED

Training exercises with FROG-5 have been sighted in several East European countries; this system could be used to launch the FROG-3 warhead. In view of the availability of FROG-3, and the limited deployment of FROG-4, the latter is believed to be non-nuclear.

In addition to FROG-3, only the FROG-7 with a diameter of 550 mm, mounted on one of a new family of eight-wheeled vehicles, is considered to possess a nuclear capability. The FROG-7 appeared for the first time in the November 1965 Moscow parade. It is expected eventually to replace the FROG-3 as a more mobile and

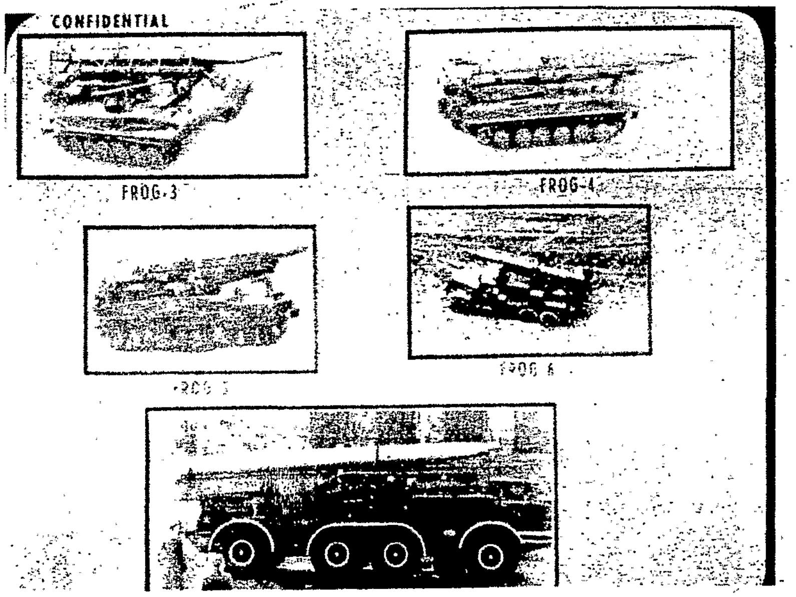


Figure 4

efficient system.

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DOE 6.2(a)

Improved design and construction of the FROG-7 results in quicker and easier warhead-to-rocket assembly, rocket component inspection, servicing, and repair. The eight-wheeled vehicle can transport the launcher system over roads at greater speeds for longer distances—up to 400 km per day—yet requires less maintenance than the tracked vehicles carrying the FROG-3, -4, and -5.

On the basis of defector reports, as well as analysis of the Soviet nuclear testing program, the following estimates were made concerning the FROG-3 warhead (see Figure 5):

a. The hooded protrusions seen immediately forward of the cylindrical section appear to be related to antenna requirements. Such hoods might be used to provide protection, and to prevent identification of small dipole antennas.

b. The nose has a probe which could measure both static and dynamic pressure; it may be associated with a baro timer system to detonate the warhead.

c. A backup radar fuze is postulated at a position immediately forward of the hoods.

d. The nuclear device probably is mounted at the forward separation line.

e. The firing set is assumed to be mounted on a sliding ring, aft of the warhead.

f. The batteries, and the adaption kit used for mating the warhead to the missile body, are probably mounted within the rear cylindrical section.

This assumed partitioning of components leads to a logical, straightforward arrangement which would be relatively easy to assemble and inspect at a forward warhead checkout area.

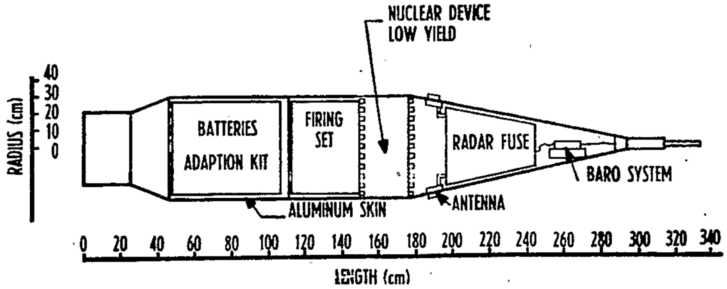
An analysis of the FROG-7 nosecone (see Figure 6) has led to these conclusions:

a. Pitot tubes are probably used in a safing and arming baro system.

b. A radar fuze is contained in the outer skin section between separation lines at stations 110 and 182.

c. Slot array antennas, protected by plastic covers, are located directly behind the nose cap, and the cap is removable to permit setting the height of burst of the radar fuze.

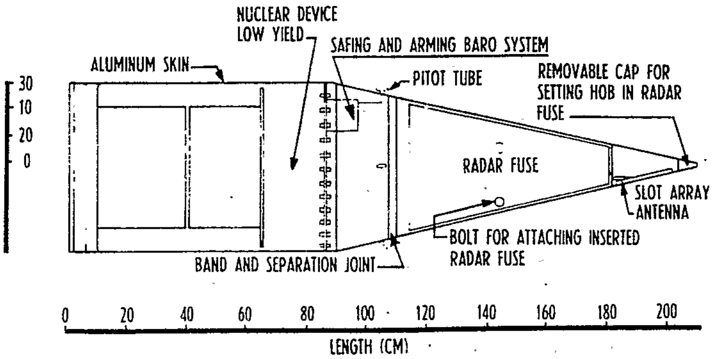
d. The nuclear device is probably mounted directly behind the ogive section, with its firing set mounted on an aft flange support. In this arrangement the adaption kit and batteries would be mounted behind the firing set, between stations 10 and 40, which affords easy access from the rear.



FROG-3 NOSECONE (U)

NUCLEAR DEVICE
LOW YIELD
RADIUS (cm)
40
30
20
10
0
BATTERIES
ADAPTION KIT
FIRING SET
RADAR FUSE
BARO SYSTEM
ANTENNA
ALUMINUM SKIN
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340
LENGTH (cm)

Figure 5



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FROG - 7 NOSECONE (U)

NUCLEAR DEVICE
LOW YIELD
SAFING AND ARMING BARO SYSTEM
ALUMINUM SKIN
PITOT TUBE
REMOVABLE CAP FOR SETTING HOB IN RADAR FUSE
30
10
20
0
RADAR FUSE
SLOT ARRAY ANTENNA
BOLT FOR ATTACHING INSERTED RADAR FUSE
BAND AND SEPARATION JOINT
0 20 40 60 80 100 120 140 160 180 200
LENGTH (CM)

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Figure 6

Although most FROG battalions presently contain only three launchers, some have been sighted in the western Soviet Union with four launchers. Most FROG battalions are expected to increase their strength to four launchers in the next few years.

Without special resupply preparation the maximum fire capability of a FROG battalion during a day's operation would probably be limited to two rockets per launcher. DELETED DOE 6.2(a)

The actual delivery capability would probably be less because:

a. Reliability figures for FROG's have not been considered.

b. Not all warheads would necessarily be nuclear.

c. Lower yields might be employed.

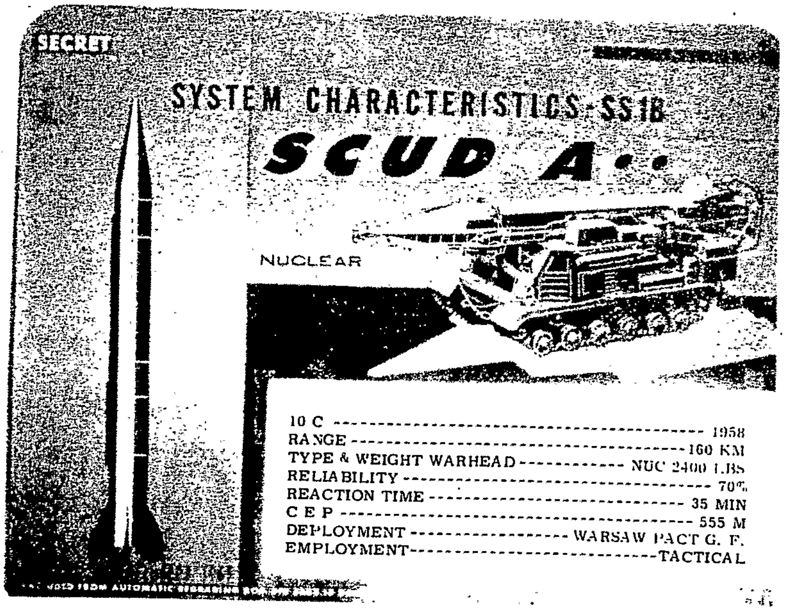
d. Poor target acquisition might limit the number of targets.

DELETED DOE 6.2(a)

The missile organic to their combined arms Army and front is the SCUD guided missile (see Figure 7). SCUD units are probably being converted from the SCUD A, which was operational in 1957, to the SCUD B, which became operational in 1961.

The SCUD A is a single stage, short range, surface-to-surface ballistic missile capable of delivering a warhead of 1900 to 2400 lbs, to a range of about 160 km. DELETED This missile is a mobile, extremely reliable, tactical weapon, that is transported, erected, and launched from a modified tank chassis. DOE 6.2(a)

The SCUD B (see Figure 8) is believed to be a modification of the SCUD A. The physical characteristics and employment of the two systems are similar. The range of the SCUD B with a nuclear warhead is 300 km. DELETED DOE 6.2(a)



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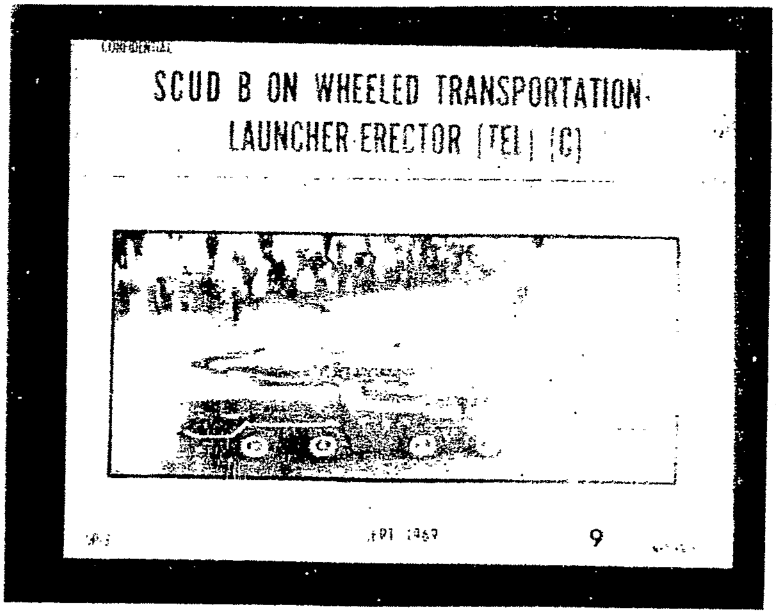
SYSTEM CHARACTERISTICS-SS1B

SCUD A

NUCLEAR

10 C -- 1958
RANGE -- 160 KM
TYPE & WEIGHT WARHEAD ------------- NUC 2400 LBS
RELIABILITY -- 70%
REACTION TIME ---------------------------------- 35 MIN
C E P --- 555 M
DEPLOYMENT ---------------- WARSAW PACT G. F.
EMPLOYMENT-------------------------------TACTICAL

Figure 7



CONFIDENTIAL

SCUD B ON WHEELED TRANSPORTATION-LAUNCHER-ERECTOR (TEL) (C)

APR 1969

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Figure 8

While the first SCUD B's were also on tracked vehicles like the SCUD A, the November 1965 Moscow parade displayed a SCUD B missile mounted on a wheeled transporter-erector-launcher. The replacement of the tracked transporter with the wheeled vehicle should reduce maintenance requirements and permit elimination of some ancillary equipment associated with the tracked transporters.

One SCUD brigade is found at Army level and up to two brigades at front level. A combined arms Army has, at full strength, a total of nine launchers. This would give a density of one SCUD launcher for every 6 to 11 km within the frontage of a typical combined arms Army.

The reaction time from arrival at a presurveyed site to actual firing is about 15 to 30 minutes. The refire time is approximately 2 hours if an assembled and checked out missile is ready at the predesignated loading point.

DELETED The actual nuclear threat from the SCUD system would more than likely be less, for the same reasons mentioned for the reduced FROG capability. The overall reliability of the SCUD system is estimated to be about 70%.[11]

DOE
6.2(a)

The SS-12 guided missile (see Figure 9) which became operational in 1965, was first seen in the 7 November 1967 Moscow parade. This missile, designated SCALEBOARD, is mounted on an eight-wheeled transporter-erector-launcher in a closed container. An article in the 11 November 1967 issue of the RED STAR describes this transporter as a highly mobile strategic launcher. The closed container implies that the system will be expected to remain on-site exposed to varying climatic conditions for extended periods of time. If so, the SS-12 may be deployed in a semistrategic or mobile role similar to the present, quick-reaction alert mission assigned to the US Pershing in Europe.

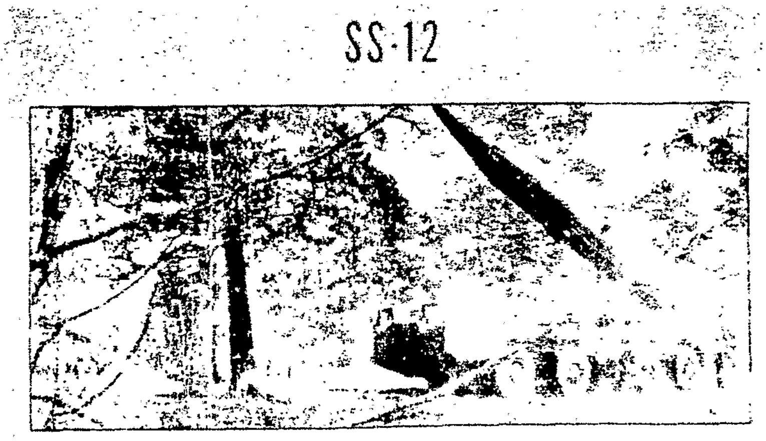

Figure 9

Compared to earlier short range ballistic missiles, the SS-12 offers improved range, yield, accuracy, and mobility. DELETED The delivery capability is approximately 925 km. The reaction time is estimated to be 15 to 30 minutes after arrival at a presurveyed site, and overall reliability is considered to be about 75%.[13] DELETED

DOE 6.2(a)

DOE 6.2(a)

It is believed that there are two or possibly three battalions of three launchers, each operational at the front level. With the SS-12, front commanders will be able to engage targets for which tactical aircraft were previously needed.

The next category of tactical nuclear weapons is cruise missiles.

The SALISH cruise missile (see Figure 10), operational in 1957, appears to be an accurate, short range missile system available for direct support of ground force operations. DELETED Reaction time is 30 minutes after arrival at a presurveyed site. Reliability is about 70%.[14]

DOE 6.2(a)

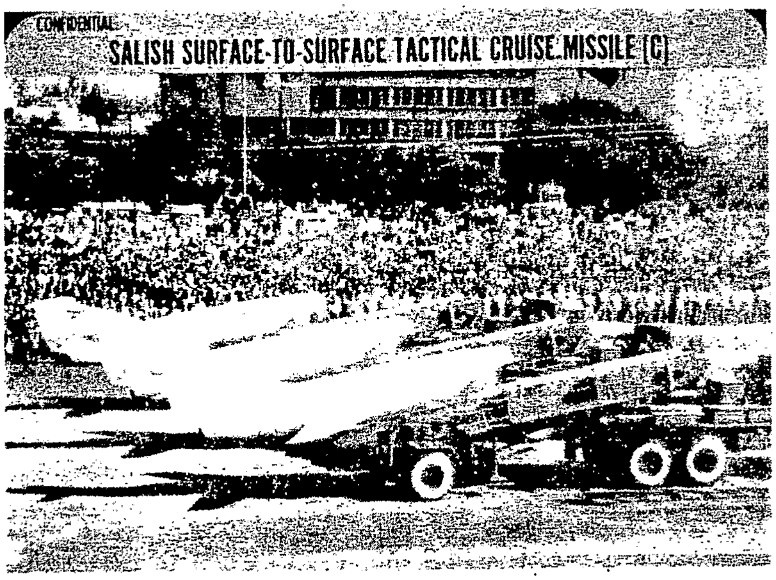

Figure 10

The SHADDOCK (see Figure 11), which became operational in 1963, is a surface-to-surface cruise missile, the nature of which can only be postulated since the body of the missile has never been seen. DELETED

In its possible use with ground forces, the SHADDOCK is believed to be employed in the cruise missile regiment, which has eight launchers. DELETED

DOE 6.2(a)

DOE 6.2(a)

the SHADDOCK is likely to be employed against other than front line targets including Army installations, depots, and reserves.[16]

SHADDOCK (U)

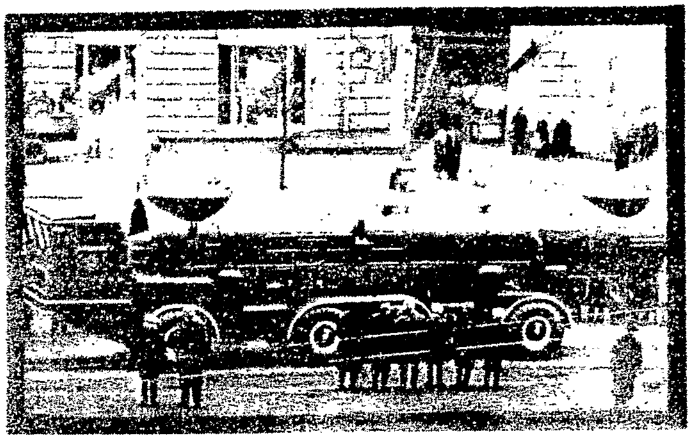

Figure 11

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DOE 6.2(a)

In addition to the ground force weapons just described, nuclear delivery systems available to front commanders could include surface-to-air missiles used in a surface-to-surface role, in addition to that nuclear ordnance delivered by aircraft organic to the tactical air army of the front.

The GANEF SA-4 surface-to-air system, shown in Figure 12, appears to be a potential candidate for use in a surface-to-surface role, but there is no evidence to indicate the existence of such a capability or a nuclear warhead for this missile.[17] The US Nike Hercules, however, may be used against surface targets at ranges up to 185 km, in addition to its normal role as an air defense system.[18]

Soviet tactical aviation has the mission of securing and maintaining local air superiority, supporting local ground operations, and providing air defense for ground forces.

The present Soviet tactical air-to-ground attack capability is represented by the aircraft listed in Figure 13. The BEAGLE, which is now obsolescent, can carry a bomb load up to 6600 pounds. The BREWER can carry a bomb load of 3300 pounds. Most of the fighters can carry at least four devices.[19]

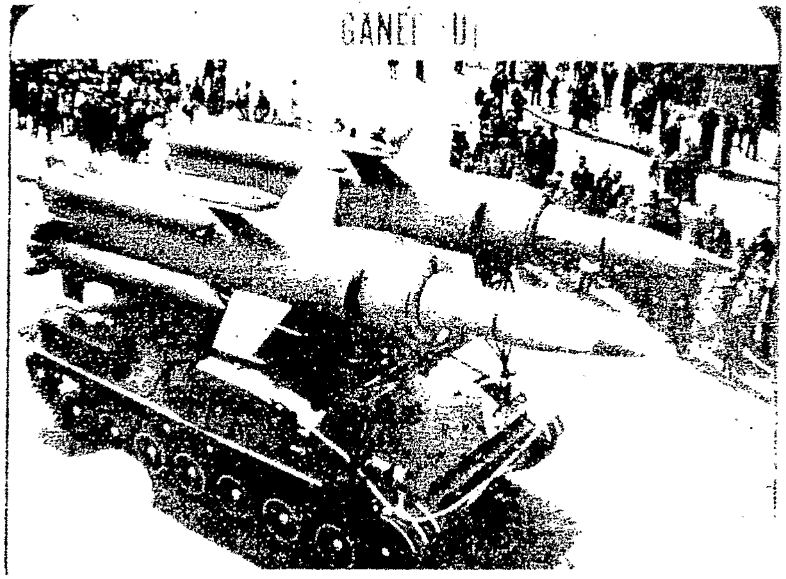

Figure 12

DOE
6.2(a)

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Figure 13

Soviet publications emphasize the importance of nuclear weapons in tactical operations. They state that nuclear fires will be directed against targets to provide the greatest effect with the least expenditure of nuclear resources, to minimize danger to friendly troops, and to minimize problems of maintenance and control.[20] Approximately 60% of the nuclear weapons under the control of ground force commanders will be used to support the main effort, with about 30% used to support exploitation forces, and 10% held in reserve.[21]

Now a word about the Communist Chinese capabilities in the nuclear weapons field.

Communist China has embarked on a nuclear weapons program which apparently has as its prime objective the development of warheads for strategic delivery systems. By concentration of effort on its military nuclear program, China apparently has been able to keep moving forward in this field despite the country's relatively limited industrial and technological resources.

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Figure 14 lists some of the characteristics of the Communist Chinese tests.

SECRET

CHICOM NUCLEAR WEAPONS TESTS

TEST	DATE
1	16 OCT 64
2	14 MAY 65
3	9 MAY 66
4	27 OCT 66
5	27 DEC 66
6	17 JUNE 67
7	24 DEC 67
*8	27 DEC 68

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Figure 14

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DOE
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DELETED

They have also undertaken a broad based program to develop missiles of all types; however, since a tactical missile has not been identified, an estimate of nuclear capability in this area cannot be made.

In summary (see Figure 15), this briefing has emphasized the paucity of information available on Soviet and Chinese nuclear capabilities, while at the same time describing the techniques employed in estimating the choice of nuclear warheads available to the Soviets, and the factors considered in assigning these warheads to delivery systems. I have discussed briefly the delivery systems available to Soviet ground force commanders from division to front level, including tube artillery, rockets and missiles, and tactical aviation. Included was information concerning estimated yields, weights, and ranges, as well as an indication of the organization and deployment of nuclear delivery systems. Finally, I discussed what is known concerning the Communist Chinese nuclear energy and missile programs which indicates that they have as a goal the development of large thermonuclear devices.

SUMMARY

1. ESTIMATING THE AVAILABILITY OF SOVIET NUCLEAR WARHEADS
2. FACTORS CONSIDERED IN ASSIGNMENT OF WARHEADS
3. SOVIET TUBE ARTILLERY
4. SOVIET ROCKETS AND MISSILES
5. SOVIET TACTICAL AVIATION
6. ORGANIZATION AND DEPLOYMENT OF DELIVERY SYSTEMS
7. MILITARY ASPECTS OF THE CHICOM NUCLEAR ENERGY PROGRAM

Figure 15

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2. National Intelligence Estimates (NIE) 11-2-69, p. 1
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18. OFFICE, Chief of ORDNANCE, TIR CD-12, Army Ordnance Corps Programs for Research and Development of Atomic Energy and Special Weapons, p. 25
19. NIPP 69, Table III, B-8, p. III-50
20. FSTC-CS-02-8-68-INT, p. 32
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23. NIE 11-2-69, p. 7
24. NIE 27 Feb 69, p. 6

Question and Answer Period

CARTER (ODDR&E): I am wondering why you did not mention the ADM capability in this Soviet inventory?

ORD: There is no doubt that they have the capability, but I have seen no evidence that there is such a thing. Do you have evidence that there is? I think there is a good chance to find out some things that possibly haven't come to our attention.

CARTER: I thought there had been some pretty good evidence that they were exercising and training with ADM's, but perhaps it is a subject we had better pursue separately.

SQUIRE (LRL): Would you like to comment on the Soviet de-emphasis of tube artillery since World War II and its apparent replacement by the nuclear missiles?

ORD: Possibly they have de-emphasized tube artillery as far as carrying nuclear weapons is concerned, but there is no de-emphasis on tube artillery. They still use it for anti-aircraft work and very successfully so. We are the ones who have de-emphasized tube artillery for AA.

SQUIRE: Have they not retired most of their artillery above the 152 mm size?

ORD: There are soft guns apparently, but they have some very accurate new 122 and 130 mm tube artillery and are still using the 152 mm. In fact, the Israelis now use the gift from the Arabs, the 130 mm, and are doing very well with it.

LAUREYNS (General Dynamics): Can you give me an estimate of delivery accuracies for some of the systems you have discussed?

ORD: Yes, I have some figures here. The FROG-3 has a CEP of about 500 meters; the FROG-7, about 490 meters, essentially the same. For SCUD A and SCUD B, they listed 935 meters; also the SS-12. The SALISH, which you recall had a range of 110 kilometers and was mentioned as an accurate cruise missile, has a CEP of 100 to 160 meters; SHADDOCK, with a 550 range, 935 meters. GANEF—remember that is normally a surface-to-air missile—they give 20 to 30 meters. I have these figures if you wish to jot them down.

MOTT (Analytic Services, Inc.): Do you have any idea of Soviet doctrine or release procedures for this rather impressive array of weaponry? How do they control it? Do they have incremental release ideas or what?

ORD: From what I have been able to read, they control it at a high level until they determine that it is required. Then the authority is given to the combined arms army or front commanders to make use of it. Out of a recent document that I read last Saturday, I picked up some information which may help to answer your question; it concerns a 1961 large scale exercise where they simulated 226 nuclear missiles and 277 tactical rockets and missiles with chemical warheads. In the first strike, their mix was 63 nuclear and 24 chemical; the second strike, 101 nuclear and 124 chemical; the third strike, 49 nuclear and 70 chemical. The other strikes took up the rest of the mix. In recent years, apparently they have been decreasing their chemical in favor of nuclear. Does that give you some indication of what you wanted to know?

ARMBRUSTER (Hudson Inst.): You gave the CEP for GANEF at 20 to 30 meters—is this in a surface-to-surface mode of operation, or surface-to-air?

ORD: They didn't mark it, but my guess would be surface-to-air.

BEATON (LTV Aerospace Corp.): Can you give me some ratio figure as to the relative strength deployment in Europe of our nuclear forces versus the Soviet, perhaps a ratio figure?

ORD: That is something which is out of my field. Is Colonel Spry here?

SPRY (ACSI): We could not make a comparison between US and foreign from the work that Dr. Ord and I do. We would have to go to some other source for this information. We don't have the data to do it.

ORD: Perhaps I should indicate that this was prepared for the Assistant Chief of Staff of Intelligence; I am actually from the Foreign Science and Technology Center and our field is S&T, or Scientific and Technical Intelligence; we do not normally get into comparative issues or order of battle. DIA usually handles the order of battle, and anything we need we get from them.

GETZINGER (Hq USCONARC): Is there a Soviet philosophy in partition of energy or emphasis on enhanced or suppressed radiation? Is there any indication of a trend in Soviet tactical weapons going to enhanced radiation or suppressed radiation? What are their capabilities in that area?

ORD: I have nothing definite on that. I cannot answer it.

GIRARD (Research Analysis Corp.): Regarding control of these weapons, you indicated a high level. Can you indicate whether the rocket and missile organizations are part of the regular artillery troops or are they KGB detachments?

ORD: You mean whether they have political detachments?

GIRARD: In fact, are the firing units Red Army artillery or are they KGB detachments?

ORD: I have no evidence that they are KGB detachments. We have taken this from a combined arms army with four motorized and one tank division, typical; and three of those combined armies, two tank armies, and a tactical air army forming a front. The units I mentioned are organic to those elements.

JANTZEN (Lockheed Cal.): Can you comment on tactical weapons in the surface-to-air role, particularly with regard to use of fractional nuclear warheads versus conventional? This is the surface-to-air role against aircraft.

ORD: We have no direct evidence that either the SA-2 guideline or the SA-4 GANEF has a nuclear warhead.

Colonel Stanley D. Fair
U. S. Army Combat
Developments Command
Institute of Advanced Studies

TACTICAL CONCEPTS IN THEATER OPERATIONS

I want to express the appreciation of the Institute of Advanced Studies for this opportunity to present the TACTO study to the symposium (see Figure 1). TACTO was completed just last week and has not yet been coordinated. Therefore, the study reflects only the views of the Institute of Advanced Studies and the findings must be considered tentative. It represents a one-year effort by five members of the Institute, supported by three contract analysts and from three to five military personnel on temporary duty with the Institute for varying periods of time. The study, when published, will appear as a main report with two supporting volumes.

TACTICAL CONCEPTS
IN
THEATER OPERATIONS

(TACTO)

Figure 1

The purpose of the TACTO study is shown in Figure 2.

TACTO PURPOSE

TO EVALUATE THE TACTICAL NUCLEAR OPTION AS AN ELEMENT OF NATIONAL POWER IN THE 1975 TIME FRAME.

Figure 2

The need for such a study may not be obvious because of the many past studies on tactical nuclear warfare. However, since 1964, with the publication of the first draft presidential memorandum on theater nuclear forces, the value of tactical nuclear weapons has been a major item of contention between OSD and the services. The strongly divergent opinions center on military requirements and concepts versus political cost. The resulting decisions have produced a consistent deterioration of our tactical nuclear capability. The TACTO study is an attempt to examine the tactical nuclear option from the national level in order to address the subjective issues that underlie the disagreement.

The TACTO study has the following objective (Figure 3).

~~CONFIDENTIAL~~

TACTO OBJECTIVE

TO DETERMINE WHETHER IT IS IN THE BEST INTERESTS OF THE UNITED STATES TO DEVELOP TACTICAL NUCLEAR WEAPON SYSTEMS AND MAINTAIN THEATER NUCLEAR FORCES CAPABLE OF SUSTAINED COMBAT AT ALL LEVELS OF NUCLEAR CONFLICT IN 1975.

~~CONFIDENTIAL~~

Figure 3

The TACTO study presents the need for the tactical nuclear option as it supports the national military strategy of deterrence, collective security, and flexible response. It then examines the military and political implications that detract from the ability of the tactical nuclear option to discourage aggression and to be executed in the best interests of the United States. Finally, the TACTO study develops the utility of the tactical nuclear option by outlining a nuclear strategy for limited war.

The tactical nuclear option supports deterrence as a principle of national strategy (Figure 4). Theater nuclear forces supplement the deterrent posture of US and allied conventional forces and complement the deterrent value of strategic nuclear forces. The deterrent value of theater nuclear forces, in turn, is enhanced by strategic nuclear forces, especially when the opponent has a strategic nuclear capability. In a similar manner, the presence of US conventional forces adds to the deterrent value of theater nuclear forces because preservation of US force integrity could be an important mission for the tactical nuclear option. Thus, the tactical nuclear option is a necessary component of the total military deterrent capability of the United States.

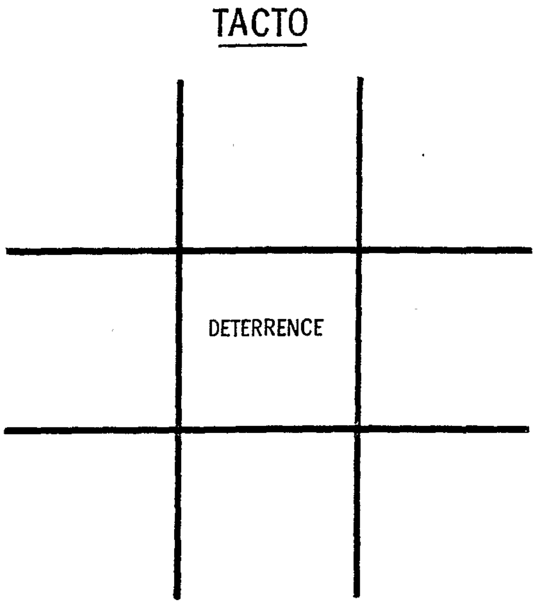


Figure 4

However, the utility of US theater nuclear forces as a deterrent depends on their credibility to potential enemies of the United States (Figure 5).

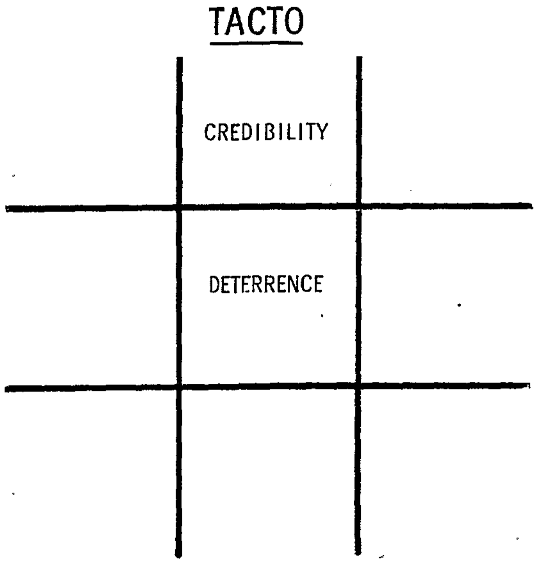


Figure 5

The Soviet Union considers that its strategic attack forces have attained parity with US strategic nuclear forces and have cancelled any advantage that the United States held previously. In Europe, Warsaw Pact forces are supported by Soviet theater nuclear forces and the Soviet Union has located nuclear weapon storage sites in Eastern Europe. Soviet theater nuclear capabilities are being expanded by increasing the number of FROG's and SCUD's available in combat units and by adding the SS-12 missile system. The continued modernization of ground and air delivery systems will also improve Soviet theater nuclear capabilities. Their strategic attack forces include MRBM/IRBM's which are targeted against NATO. Thus, Soviet theater nuclear capabilities in Europe may exceed those of the United States or at least approximate parity by 1975. The condition of mutual deterrence for the tactical nuclear capability will detract from the credibility of the tactical nuclear option as it has for the strategic nuclear option.

The Chinese Communists are not expected to have an organic tactical nuclear capability by 1975, but land operations could be supported by nuclear-capable light and medium bombers. In addition, the PRC could employ MRBM's against US and Allied Forces as well as strike countervalue targets. However, so long as the PRC nuclear capability remains small and vulnerable, she is expected to abstain from the use of nuclear weapons in Asian conflicts because of the risk of retaliation in the combat area and on her homeland.

The tactical nuclear option supports collective security as a principle of national strategy (Figure 6).

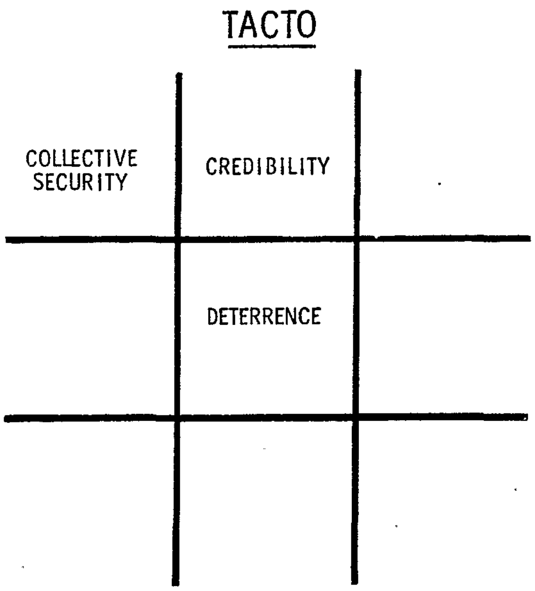


Figure 6

Volume I of the TACTO study consists of six scenarios which consider the need of the tactical nuclear option in collective security arrangements. Each scenario depicts nonnuclear aggression against a US ally, and each situation is analyzed from the viewpoint of the theater commander and is re-examined from the national level.

The need for the tactical nuclear option was most obvious in those situations that portrayed such numerically superior enemy strength that US and Allied Forces were inadequate to achieve a favorable outcome. In addition, the scenarios suggest that a tactical nuclear capability is needed to terminate conventional aggression before the conflict can expand to involve other areas or other combatants and to avoid a prolonged nonnuclear war.

Most importantly, the scenarios point out the need for theater nuclear weapons early in conflicts when favorable results appear more probable than later when friendly force capabilities are degraded by conventional operations, and reserves are unavailable to exploit the effects of weapon employment. Military and political control should be less difficult and more positive early in the military campaign than later when communications may be uncertain and when large numbers of nuclear weapons may be required in an effort to salvage the military situation. Collateral damage and civilian casualties will be less than if first use is delayed. Early first use adds to the credibility of the tactical nuclear option by re-establishing the deterrent. Delayed use implies desperation and a lack of political resolve as well as increasing the possibility of nuclear retaliation or escalation.

The scenarios of Volume I are limited to the enemy's nonnuclear option. Appendix VIII continues the consideration of the need for the tactical nuclear option in response to other enemy options. These options involve the tactical use of nuclear weapons in a theater of operations and strategic nuclear attack in conjunction with a nonnuclear attack or with the tactical use of nuclear weapons.

The need for the tactical nuclear option in collective security arrangements in these situations is to counter the tactical nuclear capability of the enemy with theater resources, in an attempt to limit the conflict and to support the SIOP if necessary. Countering the MRBM launchers of the Soviet Union and Communist China is a vexing problem in these situations. If these launchers are moved out of the enemy homeland, theater nuclear forces need the capability to neutralize them. Except for aircraft, and perhaps Pershing in Europe, this capability is not now available (see Figure 6).

Utility of the tactical nuclear option in collective security arrangements is affected by the reaction of US Allies and hostile public opinion (see Figure 7).

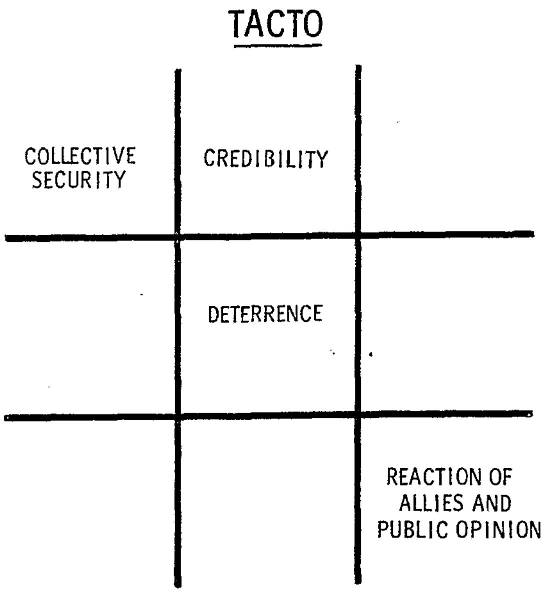


Figure 7

The individual defense strategies of NATO allies stress the deterrent value of nuclear weapons, but their concepts of employment, if deterrence fails, do not include a major nuclear war limited to Europe. They do not view US theater nuclear forces as a US commitment independent of US strategic nuclear forces.

Our NATO allies continually seek assurances that US nuclear weapons will be used in the defense of Europe and prefer that definite guidelines be established for their use. The United States has resisted a precise formula for contingencies that would demand a nuclear response and has insisted that each form of aggression should be evaluated as it occurs to determine an appropriate defense. To date NATO has deferred to the US position but maintains that the US is obligated to consult within the North Atlantic Council before nuclear weapons are used. The Athens guidelines of 1962 provide for such consulting but only if time permits.

Of greater significance is the exchange of national views since 1965 in the NATO Nuclear Planning Group. In 1968 the discussions produced an agreement-in-principle on consulting which holds that special weight on decision making is to be accorded the host country, the owner of the weapons, and the owner of the delivery systems. While a US decision to use nuclear weapons cannot be vetoed by other allies and they cannot override a US veto, those allies with special weight will have an influence on the US decision.

Another aspect that may affect US use of nuclear weapons for mutual defense is the attitude of the general public in Western Europe and Japan toward nuclear weapons. There is a marked difference between the view of political leaders and of the general public in Western Europe on the use of nuclear weapons. A majority of the public in Western Europe is strongly opposed to the use of nuclear weapons against front line troops in the event of nonnuclear aggression by the Warsaw Pact. Most of the people interviewed were against such use even if it were the only way to stop the enemy. The major factor in their thinking was the feeling that the tactical use of nuclear weapons would inevitably escalate to attack of population centers. This Western European public opinion, considered in conjunction with similar Danish and Norwegian attitudes, would seem to indicate serious reservations among the general public about plans for the nuclear defense of NATO.

In Japan the hostility of the people toward nuclear weapons is historic. The significance of Japanese public opinion lies in its influence on the Japanese government in assuming a larger role in Asia and in negotiations on the return of Okinawa to Japan. Public opinion might dictate the official position of Japan on the tactical use of nuclear weapons in Korea and deny the United States any staging areas for conventional forces.

The last principle of national strategy is flexible response (see Figure 8).

TACTO

COLLECTIVE SECURITY	CREDIBILITY	
FLEXIBLE RESPONSE	DETERRENCE	
		REACTION OF ALLIES AND PUBLIC OPINION

Figure 8

The US tactical nuclear capability provides the President a flexible nuclear option in the application of combat power to meet enemy threats below the level of general war. The tactical nuclear option represents a lesser alternative than the employment of strategic nuclear forces, thereby reducing the risk of strategic exchange. The US tactical nuclear option is needed to provide a flexible range of nuclear capabilities from within theater resources.

The most restrictive, least violent level of nuclear weapons employment is a tactical demonstration. This controlled and selective use of one or a few nuclear weapons has the objective of warning the enemy that the US and her allies are willing to take risks greater than nonnuclear conflict. Because of the risk of retaliation, the military must be alert for an enemy nuclear response and political authorities must be aware of the possibility of nuclear war.

The next level of nuclear weapons employment is in responding to conventional aggression. This capability is needed to preserve the integrity of US and Allied Forces, to gain time for friendly forces to improve defenses and obtain additional reserves, and to stop the forward momentum of the attack.

US theater forces need the capability to respond to enemy use of theater nuclear weapons. This capability is needed to counter the theater nuclear power of the enemy, to cause an enemy to consider the wider risks and uncertainties of continuing his course of action, and to establish limitations on the use of nuclear weapons.

US forces must be capable of continuing theater nuclear operations beyond an initial exchange, if it is necessary to achieve political and military objectives. This capability is needed to force the aggressor to de-escalate or accept the risk of a strategic attack. The capability to fight a theater nuclear war might deter general war.

In a general war situation the tactical nuclear option is needed to reduce or eliminate enemy capabilities for effective tactical operations. Theater nuclear forces can attack CINCEUR/CINCPAC-identified strategic targets that are not included in SIOP targeting. They can also participate in SIOP operations by engaging time-sensitive targets.

Utility of the tactical nuclear option in flexible response is questioned because of doubts about our command and control capabilities and the possibility of escalation (see Figure 9a).

TACTO

COLLECTIVE SECURITY	CREDIBILITY	
FLEXIBLE RESPONSE	DETERRENCE	
CONTROL AND ESCALATION		REACTION OF ALLIES AND PUBLIC OPINION

Figure 9a

The United States has deployed thousands of nuclear weapons to overseas areas, and concern has been expressed by some US officials over the possibility of nuclear accidents or incidents and inadvertent or unauthorized use resulting in an unwanted nuclear war. Control procedures in peacetime generally alleviate these fears, but command and control concepts for nuclear war do not appear to be sufficiently responsive or flexible for full utilization of the tactical nuclear option.

Transmission of a selective release request involves decoding, evaluation, amendment, encoding, and dispatch at each intermediate headquarters, a cumbersome and time consuming procedure. If selective release authority is approved by the President, the Joint Chiefs of Staff require the theater commander to report within four hours on the detonation of each weapon, and include time of detonation, target type and location, yield employed, height of burst, delivery means, and estimated results. This procedure would be suitable for initial use of a few theater nuclear weapons that might be employed in a demonstration, but not for the use of a few hundred weapons which might be required to respond to nonnuclear aggression.

There are no known procedures for requesting general release of theater nuclear weapons independent of executing the SIOP. While the theater commander might request selective release of all available nuclear weapons, the reporting requirements would have to be relaxed to the daily summary required under general release.

In addition to these shortcomings of our own ability to use nuclear weapons is the possibility that the limited use of theater nuclear weapons might lead to unlimited theater nuclear warfare or to a strategic exchange. The probability of nuclear escalation, however, is not certain but is determined by a complex set of relationships between the nuclear powers and the specific circumstances of the use of theater nuclear weapons.

The highest escalatory potential of all hostile acts would be the threat to or attack of the homeland of a major nuclear power. Theater nuclear weapons must be used in such a way that the homeland of the Soviet Union or the PRC is not threatened.

The enemy can distinguish, on a timely basis, between the tactical application of nuclear force and a threat to his homeland by the choice of delivery system.

Restraint in the number of theater nuclear weapons used initially and restrictions on yields would have a bearing on the escalatory potential of the tactical nuclear option. The weapons chosen and the targets selected must be consistent with and reinforce verbal declarations communicated to the enemy as to the objectives of the attack. The objectives should be limited and must be adhered to even if the initial use of nuclear weapons appears to offer an opportunity to achieve a greater objective.

The condition of parity in strategic nuclear forces between the United States and the Soviet Union tends to inhibit escalation. The awareness of national leaders of the consequences of a strategic exchange should tend to deter escalation after theater nuclear operations have been initiated. Therefore, the tactical use of nuclear weapons will not necessarily lead to strategic attack because the deterrent value of strategic forces which maintained stability prior to hostilities will still inhibit escalation (see Figure 9b).

TACTO

COLLECTIVE SECURITY	CREDIBILITY	
FLEXIBLE RESPONSE	DETERRENCE	UTILITY
CONTROL AND ESCALATION		REACTION OF ALLIES AND PUBLIC OPINION

Figure 9b

Thus, the need for a tactical nuclear capability is convincing, but the military and political implications associated with the tactical nuclear option detract from utility. Utility cannot be demonstrated unless the uncertainties and risks are resolved or minimized to the satisfaction of political authorities (see Figure 9c).

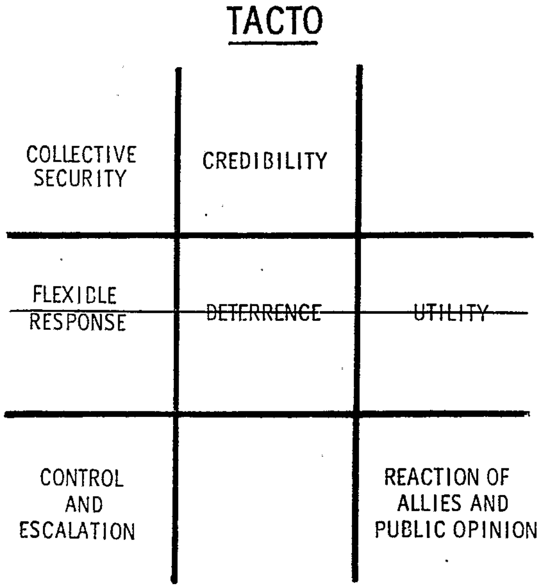

TACTO
COLLECTIVE SECURITY
CREDIBILITY
FLEXIBLE RESPONSE
DETERRENCE
UTILITY
CONTROL AND ESCALATION
REACTION OF ALLIES AND PUBLIC OPINION

Figure 9c

A national decision to develop, maintain, and use theater nuclear weapons will be easier to obtain if political authorities have confidence in the military concept for theater nuclear operations. We might be able to overcome our tradition of non-use if we have a nuclear strategy for limited war, one that rejects the current preoccupation of nuclear strategy with general war.

The TACTO study outlines a nuclear strategy for limited war that consists of five principles (see Figure 10).

NUCLEAR STRATEGY FOR LIMITED WAR

1. CREDIBLE THEATER NUCLEAR FORCE POSTURE.
   (DIFFERENT DETERRENT MISSIONS FOR ASIA AND EUROPE)
2. TWO NUCLEAR THRESHOLDS.
   (EARLY USE OF TACTICAL WEAPONS PLANNED)
3. LIMITED OBJECTIVES.
   (A DIFFERENT CONCEPT OF "WINNING")
4. LIMITED CAPABILITIES FOR THEATER NUCLEAR FORCES.
   (MUST NOT THREATEN OR ENGAGE HOMELAND TARGETS)
5. SELECTIVE USE OF STRATEGIC NUCLEAR FORCES.
   (PREVENTS SANCTUARY WAR)

Figure 10

To achieve a credible deterrent posture for theater nuclear forces it is necessary to recognize the differing capabilities of our potential enemies. In Asia the United States can maintain superiority over the PRC in tactical nuclear capabilities in 1975, and the deterrent utility of theater nuclear forces is their ability to discourage nonnuclear aggression by the massive land forces of the PRC.

In Europe, the Soviet Union has achieved a formidable tactical nuclear capability and is enlarging and improving it. The deterrent utility of theater nuclear forces in Europe is their ability to dissuade Soviet first use. The test of sufficiency is the enemy's awareness that our theater nuclear forces can survive his attack, nuclear or nonnuclear, and cause him extensive damage.

The national security interests of the United States demand that a nuclear war, if it occurs, must be kept limited. Therefore, our plans should accommodate a concept of two nuclear thresholds: a tactical threshold and a strategic threshold. This concept parallels that part of West German strategy which calls for early use of theater nuclear weapons. US plans for early use, if made known to NATO, should satisfy the Allied insistence on guidelines. However, that would be the limit of US concessions to her NATO allies, because the rationale for early use is ultimate benefit for the United States. Early use—aside from the advantages I pointed out previously—constitutes a low tactical threshold. Early use of theater nuclear weapons raises the strategic threshold, because of the range of capabilities available with the tactical nuclear option and the opportunities for negotiation or otherwise ending the conflict before we must resort to strategic nuclear forces.

When theater nuclear weapons are used, acceptance of limited objectives is essential. The objective in theater nuclear operations might not be the absolute defeat of enemy forces or capitulation of enemy governments but a lesser form of "victory." We must allow the enemy alternatives other than general war or unnecessary expansion of the conflict. The purpose of using theater nuclear weapons is to convince the enemy that he will lose more from continued aggression than he could possibly gain. This concept of "winning" seeks to achieve conditions that will result in ending the conflict under conditions acceptable to the United States and her allies.

The risk of escalation can be reduced further by limiting the means available to theater nuclear forces. The intentions of the United States to limit a nuclear war should be understood if theater nuclear forces are incapable of threatening or engaging targets in the Soviet or PRC homelands. The use of ADM and nuclear artillery in response to a nonnuclear attack would indicate clearly that the enemy homeland is not threatened. The additional use of nuclear missiles in response to a nuclear attack, if employed in the counterbattery role, would be a signal to the enemy of US intentions to limit the nuclear war. Other constraints that must be accepted to minimize the risk of escalation may include restricting the initial employment of theater nuclear weapons to the territory of allied nations and the use of nuclear yields that produce less than the desired effects.

The strategic nuclear option, used selectively, has a role in the nuclear strategy for limited war, but the complete SIOP should be reserved as the deterrent to attack of the United States and its execution ordered only when there is no other feasible course of action. The selective and controlled use of strategic nuclear forces would be appropriate if the Soviet Union or the PRC is launching MRBM/IRBM from the sanctuary of their homeland. If these missile systems are moved out of sanctuary to the territory of a buffer state, theater nuclear forces should have the capability of engaging them.

The conclusions of the TACTO study are shown in Figure 11.

CONCLUSIONS

1. THE TACTICAL NUCLEAR OPTION IS A NECESSARY AND POTENTIALLY USEFUL ELEMENT OF NATIONAL POWER FOR THE UNITED STATES IN THE 1975 TIME FRAME.
2. THEATER NUCLEAR FORCES DETER ENEMY USE OF NUCLEAR WEAPONS, SUPPLEMENT THE DETERRENT POSTURE OF CONVENTIONAL FORCES, AND COMPLEMENT THE DETERRENT VALUE OF STRATEGIC FORCES.
3. IF DETERRENCE FAILS, THE TACTICAL NUCLEAR OPTION PROVIDES THE PRESIDENT A RANGE OF THEATER NUCLEAR CAPABILITIES TO MEET ENEMY THREATS BELOW THE LEVEL OF GENERAL WAR.
4. THE DECISION TO USE THEATER NUCLEAR WEAPONS WILL BE INFLUENCED BY POLITICAL CONFIDENCE IN THE MILITARY ABILITY TO CONDUCT A LIMITED NUCLEAR WAR.
5. THE DECISION TO USE THEATER NUCLEAR WEAPONS WILL BE INFLUENCED BY THE INTERESTS OF ALLIES AND THE PERCEIVED RISK OF ESCALATION.
6. ESCALATION IS NOT INEVITABLE IF THEATER NUCLEAR WEAPONS ARE USED WITH DISCRETION TO ACHIEVE LIMITED OBJECTIVES.
7. THE EMPLOYMENT OF THEATER NUCLEAR WEAPONS IN SUPPORT OF US NATIONAL SECURITY INTERESTS MAY CONFLICT WITH ALLIED INTERESTS.
8. THEATER NUCLEAR WEAPONS WOULD BE MOST USEFUL IF THE POLITICAL DECISION IS MADE TO AUTHORIZE EARLY EMPLOYMENT.

Figure 11

The recommendations of the TACTO study are shown in Figure 12.

RECOMMENDATIONS

1. DELETED

DOE 6.2(a)

2. THAT THE RESPONSIVENESS AND FLEXIBILITY OF US COMMAND AND CONTROL PROCEDURES FOR THEATER NUCLEAR OPERATIONS BE IMPROVED.
3. THAT THE OUTLINE OF NUCLEAR STRATEGY FOR LIMITED WAR PRESENTED IN THIS STUDY BE CONSIDERED IN THE FORMULATION OF A CONCEPT FOR THEATER NUCLEAR OPERATIONS.

Figure 12

That completes my presentation. Are there any questions or comments?

Question and Answer Period

GARWIN (IBM): Clearly, from your presentation, the side which does not use nuclear weapons in response to a nuclear assault is at a big disadvantage; but is there an advantage to the United States in the first use of nuclear weapons against a massive conventional Soviet attack?

FAIR: In Volume I of our study, we went through, for several months, what you could consider as political military games. We developed scenarios for hypothetical conflicts over Berlin, Korea, Iran, Turkish Thrace, Central Europe, and even Norway. It is our feeling that where you are obviously outnumbered, where the conventional defense is doomed to failure, nuclear weapons can be useful, not only in destruction of enemy forces (which really is a secondary purpose), but primarily to re-establish deterrent which has been lost by the conventional aggression, to give them this final warning before you do continue with the nuclear weapons. We felt it has use from both aspects—as a deterrent and as a destruction force.

GARWIN: Why, at that time, should the enemy stop and be further deterred, once he makes the decision to move conventionally? Believing that he can win, he is likely to carry through with nuclear weapons on his side, and if your posture is more vulnerable to nuclear weapon attack, then he is likely to win at that level also. From the point of view of the local commander, or even the theater commander, one might imagine that anything would go to prevent defeat, but that is not necessarily in the national interest or in the interest of the ally on whose territory we might be fighting.

FAIR: The only thing I can say is that no one knows how a nuclear war might go. We don't know that they don't have secret instructions to the effect that, when the first nuclear weapons are used in defense, that stops everything, and they go back home and think about it some more. This gets back to what I emphasized repeatedly throughout this study: the necessity for early use. If you catch the enemy at the border where there is no big loss of face, where comparatively less loss of forces is involved, where he can reconsider his course of action, where he is not deeply committed to his battle plan, and he isn't half way to the Rhine when you suddenly use nuclear weapons, at this point we think that, if you do use nuclear weapons, the possibility of ending the war at that time is as likely as his counter-use of nuclear weapons. Anything could happen.

GIRARD (RAC): I believe you discussed this in a setting of strategic parity between the respective homelands, and if this is so, I am struck by the fact that apparently they are expected to be deterred rather strongly from taking nuclear risks, whereas the whole point of this study is that we are not inhibited by this to any great extent. Would you develop your thoughts on that, please?

FAIR: What we have said is that the stability which has been promoted by the strategic forces, has actually permitted or caused instability in lesser forms of combat. As you approach parity in theater nuclear forces, which I believe is about to happen or has happened with the Soviet Union, then you produce an imbalance in lesser forms of combat, which would be the conventional aggression. We feel that we can't "win" in Europe. We don't plan not to win; but we don't believe, if they have parity in theater nuclear forces and superiority in ready combat power of nonnuclear forces, that we can win. But we can cause the enemy a lot of damage. We can get in there and make him consider what he has started and the ultimate consequences—our strategic punch held in reserve—of continuing this course of action. That is all we can hope to do—to cause him unacceptable damage just as we do now in our strategic deterrent.

GIRARD: You are really assuming a situation in which we have strategic superiority between homelands in the time frame you are talking about.

FAIR: If I understand your question, it has to do with PRC?

GIRARD: No, I am talking about Russia. I am just asking you if you embed your concept in a US strategic superiority advantage over Russia? You assume the other parity is coming along rather quickly, but you are not assuming that we are losing our homeland superiority?

FAIR: We have lost that.

GIRARD: You are saying that we have lost that?

FAIR: May I extend that? I am saying that in the Soviet view we have lost it. They consider their strategic attack forces to be at a parity with ours. They can do us unacceptable damage—that's the point. Parity, superiority, what does it mean? It means that we can't accept being attacked by the Soviet strategic forces.

GIRARD: This makes my bewilderment more acute, in that we appear to have a one-way parity operator here in the study; they are damped and we aren't. We take nuclear initiatives but we expect the parity situation to squelch their responses?

FAIR: We expect the strategic parity to stop it from going all the way, yes.

DAYE (Air War College): You addressed your study primarily to Europe as a vital area of interest. Did you address any portion of it to using tactical nuclear weapons against a nonnuclear power, for example, in going to the defense of Thailand, Cambodia, or Laos? If you eliminated it, why did you do so?

FAIR: We did consider this in the study of Korea. The way we structured the study was to permit North Korea, by accident or by design, to invade South Korea with the objective of uniting the country without obligation of the PRC. You may question the validity of such assumed invasion due to the inequity of combat forces—it would appear that South Korea could stand alone and defeat North Korea and that US assistance would even make the balance more in our favor. DELETED

DoE 6.2(a)

In looking at this situation—in which you have the use of nuclear weapons against a nonnuclear capable power such as—

North Korea—we felt that the military need was marginal at most, but that the political advantages were fairly high. For example, you can deter the PRC from entering into the conflict—in other words, enlarging the conflict; you might be able to terminate the conflict quickly, thus eliminating the domestic problems of a prolonged nonnuclear war.

DAYE: Your conclusions, however, were the same in both aspects when you considered using it against a nonnuclear as compared to a nuclear power—or did you come out with a separate set of conclusions?

FAIR: No, the conclusions were broad, applied to the entire study, and I must repeat again, tentative.

COON (Hq USSTRICOM): On the mechanics of the study, why don't you expect coordination and possible release time, framewise?

FAIR: We were to submit the coordination draft on the 15th; we will actually beat that by a week, it will be on the 8th of September. We anticipate that we will get comments back within four weeks from our overseas friends, and from USAREUR Pact in five weeks. A week will be allowed for revision on the basis of comments, and it will be out for distribution on October 28.

BURCHINAL (USEURCOM): There is one point that is a little difficult for me to step over on this one—although I can see it from a US national point of view—and that is the introduction of the pieces of limited nuclear conflict possibility in Europe and still keeping the Europeans with us. Any nuclear use in Europe, in their view, doesn't lend itself to limited war because it is their survival which is at issue and they have always insisted on an indivisibility in the nuclear deterrent from the use of tactical nuclear weapons right through to the SIOP. We don't have enough forces to implement such a strategy or such capability on a national only basis, so I would think the study should look for more solid props in this particular area.

DOE 6.2(a)

FAIR: We recognize that problem. It is a very difficult one. DELETED They won't even discuss the possibility that a theater nuclear war could be limited just in Europe without involving us. Their strategy envisions a few weapons, a demonstration perhaps, as a deterrent, and then implementation of the SIOP. I believe they could go along with responding to enemy first use, but on No. 4 (Figure 11) we recognize that in the NATO Nuclear Planning Group or discussions among military, this possibility is never recognized.

AGNEW (LASL): As a comment, you might think that France would not go along with you on that.

WRIGHT (RAND Corp.): You mentioned two thresholds. I wondered if you used Minute Man in a counter-battery role against SS4's, what threshold you'd be at?

FAIR: You'd be in the strategic threshold.

WRIGHT: You mentioned that as part of the option?

FAIR: I am sorry; I meant army missiles.

FOWLER (DDR&E): You mentioned favorably the early use of nuclear weapons. Could you say what release time you are thinking of or you assumed in your study? What, if any, improvements would that require over the present control procedures?

FAIR: Within the present selective release request, is the possibility of conditional release authority. It is our feeling that it is not beyond the realm of possibility that SACEUR should have conditional release authority on ADM's and nuclear authority—Condition I release and authority contingent on massive invasion of Europe. So by "early," I mean before the war starts. For other parts of the world we have talked mainly about D-day, assessment during D-day as to what the effects might be and so on, but in Europe we are talking about predelegation.

FOWLER: Then your assumptions did not require any significant improvement in the present control procedure—just a change in definition and delegation?

FAIR: No. What we are saying is that the selective release authority, as the military has imposed it on itself, is too stringent, not responsive. If I have got to report all those details on the use of each single weapon, if the request must go through every channel and be voted on there and held up until they agree that there is an emergency, it is too slow. If there is no general release authority other than implementing the SIOP, we have defeated ourselves before we start, because there is no way that a field commander, for example, could wage a nuclear war—which is No. 4 on the chart—without having the SIOP going along with it.

SALET (US Mission to NATO): I don't have a question, but a comment. I believe it was in your Recommendation No. 2 that you were discussing greater flexibility in US command and control procedures. (This is more or less a follow-up to General Burchinal's comment.) I would suggest that perhaps you would want to think more in terms of greater flexibility of NATO command and control procedures. I would add that, in discussing early use, for example, of "tac nucs," particularly in this political time frame, it is vital that the credibility of the tactical nuclear deterrent, insofar as European thinking is concerned, not be diminished. As General Burchinal says, we are going to continue to carry the Europeans along with us. I do think it is vital that we think of these problems, not in terms of a US unilateral war in Europe, but of a NATO situation.

GARWIN: In the case of a massive conventional attack by a strong government like that of North Korea or North Vietnam against their neighbors South Korea or South Vietnam, why could one not use a demonstration and then strategic weapons to gain limited goals on our side, namely to have the other guy pull back to the status quo before the war? Do you exclude such a use of nuclear weapons?

FAIR: No, we do not. In our scenarios we did discuss a demonstration against a nonnuclear capable power—a nonpunitive demonstration—in other words, no damage to its forces but merely, "Look, fellows, I have this power; stop, go back, and think it over." We also considered the use of strategic forces—in other words, selective applications of strategic forces in laying down a belt across North Korea—this sort of thing. We feel, however, that you must view this from Soviet eyes or PRC eyes, consider what are they thinking if you use this kind of force—force that came from the US and attacked a puppet state or buffer state, if you will. Whereas, if you have this force within your resources, and they know it is there and can be used, we feel that the chances of escalation are much less. For this sort of thing, you could use, for example, a carrier off shore, or land forces who have organic capabilities.

GARWIN: That is not really so clear to me as all that. I can't imagine, since all we want is for the other man to pull back, that we could in fact attack his cities or his homeland so long as he is a nonnuclear power himself.

FAIR: But he has nuclear capable friends; behind every nonnuclear power there is someone with a nuclear weapon.

GARWIN: That's right, and they would start a war any time, if that's what they want.

FAIR: That's right; I agree.

Francis E. Armbruster
Hudson Institute

THE DUAL CAPABILITY DILEMMA: A SOLUTION

Editor's Note: Due to technical difficulties, Dr. Armbruster's talk was not recorded. Since we were unsuccessful in obtaining a copy of his talk for inclusion in these Proceedings, only the material used on his slides and the discussion following the talk are included in this document.

CONVENTIONAL DEFENSE

TACTICAL NUCLEAR DEFENSE

Figure 1

NON-REINFORCED WARSAW PACT THREAT

REINFORCED WARSAW PACT THREAT

Figure 2

BALANCE OF FORCES

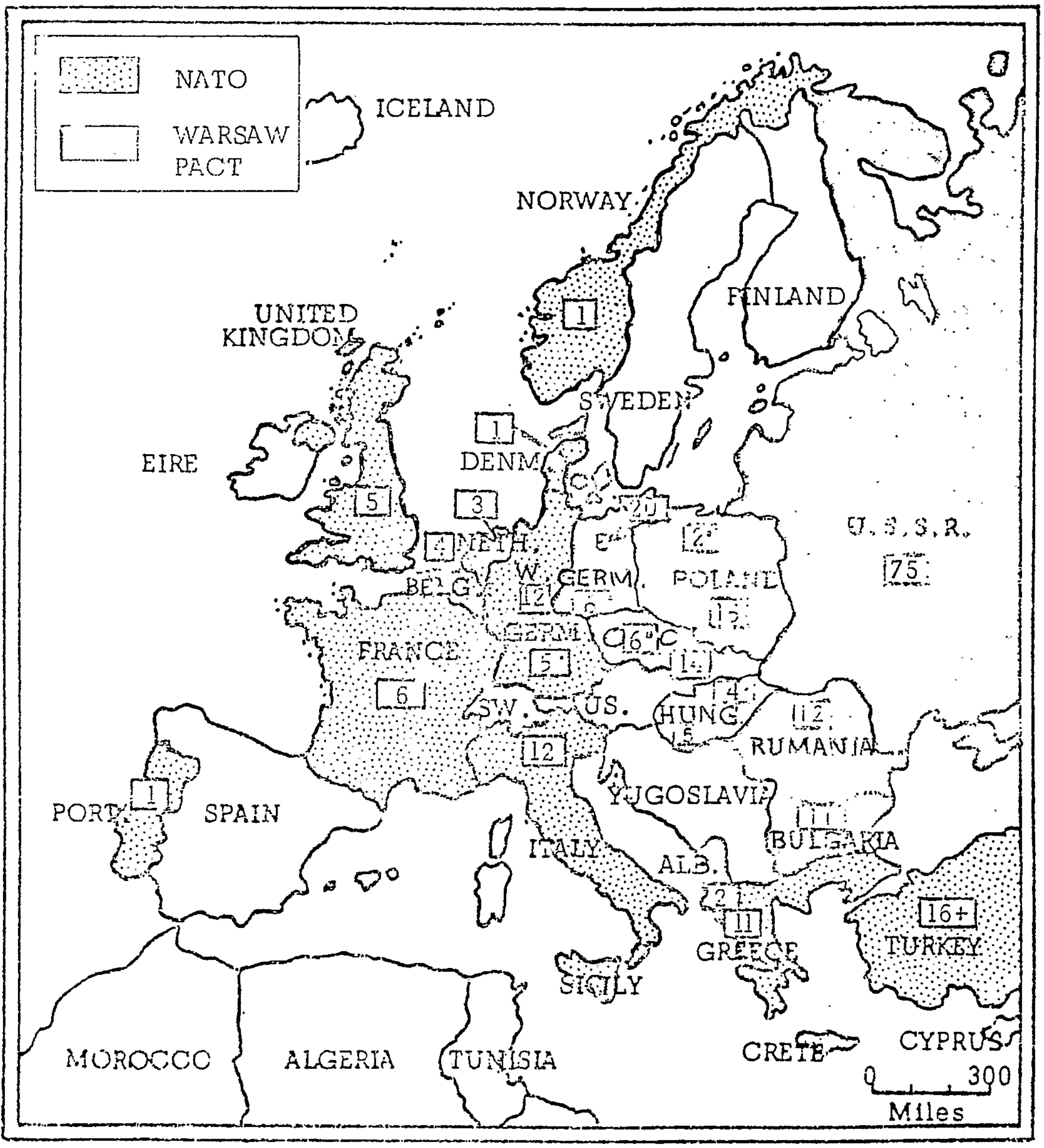

NATO
WARSAW PACT
ICELAND
NORWAY
FINLAND
UNITED KINGDOM
SWEDEN
EIRE
DENM
NETH.
BELG.
W. GERM.
POLAND
U.S.S.R.
FRANCE
GERM.
SW.
US.
HUNG.
RUMANIA
PORT.
SPAIN
YUGOSLAVIA
BULGARIA
ITALY
ALB.
GREECE
TURKEY
SICILY
MOROCCO
ALGERIA
TUNISIA
CRETE
CYPRUS
1
1
5
3
4
12
20
2
75
15
6
5
12
4
12
5
1
11
2
11
16+
0
300
Miles

Figure 3

TOTAL LAND FORCES CENTRAL FRONT

WARSAW PACT

35	WARSAW PACT DIVISIONS WITHOUT S.U.
20	SOVIET FORCES GERMANY
2	SOVIET FORCES POLAND
6	SOVIET FORCES CZECHOSLOVAKIA
63	TOTAL DIVISIONS

NATO

26	NATO DIVISIONS (2 BAOR, 6 FRENCH DIVISIONS)
5.3	AMERICAN 7TH ARMY
31.3	TOTAL DIVISIONS

Figure 4

SOVIET EXPEDITIONARY FORCE

TANK DIVISIONS 10

SIZE OF DIVISIONS--9,000 MEN

NUMBER OF TANKS--350

MECHANIZED DIVISIONS 10

SIZE OF DIVISIONS--10,500 MEN

NUMBER OF TANKS--190

TOTAL TANKS 5,400

Figure 5

EAST GERMAN FORCES

ARMY--6 DIVISIONS

2 ARMORED

4 MOTORIZED

TOTAL STRENGTH: 85,000 MEN

AIR FORCE

18 FIGHTER-INTERCEPTOR SQUADRONS

(16 AIRCRAFT IN COMBAT SQUADRON)

AIRCRAFT

MiG-19, MiG-21, MiG-17

Figure 6

POLISH FORCES

ARMY--15 DIVISIONS

5 ARMORED
8 MOTORIZED
1 AIRBORNE
1 AMPHIBIOUS ASSAULT

TOTAL STRENGTH: 185,000 MEN

AIR FORCE

6 LIGHT BOMBER SQUADRONS
45 INTERCEPTOR SQUADRONS
14 GROUND-SUPPORT AND RECONNAISSANCE SQUADRONS

AIRCRAFT

MiG-17, MiG-19, MiG-21, IL-28

Figure 7

CZECH FORCES

ARMY--14 DIVISIONS

5 TANK
9 MOTORIZED

TOTAL STRENGTH: 175,000 MEN

AIR FORCE

5 INTERCEPTOR REGIMENTS
4 GROUND-ATTACK REGIMENTS

AIRCRAFT

MiG-17, MiG-19, MiG-21, MiG-15

Figure 8

AMERICAN SEVENTH ARMY

2 ARMORED DIVISIONS

2 MECHANIZED DIVISIONS

1 MECHANIZED DIVISION (LESS TWO BRIGADES)

2 ARMORED CAVALRY REGIMENTS

1 BRIGADE IN BERLIN

TOTAL STRENGTH: 215,000 MEN

Figure 9

GERMAN ARMY

PANZER DIVISIONS	3
PANZER GRENADIER DIVISIONS	7
MOUNTAIN DIVISIONS	1
AIRBORNE DIVISIONS	1
MEN PER DIVISION	15,000 - 16,000
TOTAL TANKS	2,900

Figure 10

SOVIET PLANNER'S NATURE

1. HE NORMALLY PLAYS LONG SHOTS ONLY WHEN LITTLE IS RISKED AND MUCH CAN BE GAINED (FISHING EXPEDITIONS)
2. HE WOULD LIKE NUMERICAL "CERTAINLY" OF SUCCESS BEFORE HE COMMITS HIS FORCES
3. HE MAY HAVE SOMEWHAT OF A COMPLEX ABOUT SOVIET "BAD LUCK" IN INITIAL PHASES OF WARS FROM THE PAST
4. HE RECOGNIZES THE NUCLEAR THRESHOLD

Figure 11

AN IMPORTANT DISTINCTION

1. PROBLEM OF DEFENSE AGAINST UNREINFORCED SOVIET EXPEDITIONARY FORCE
2. PROBLEM OF DEFENSE AGAINST FULL SOVIET ARMY

Figure 12

A REINFORCEMENT THRESHOLD

1. TO CREATE A NEW LINE OF DETERRENCE
2. DETERRENCE OF REINFORCEMENT VS. DETERRENCE OF ATTACK

Figure 13

1892, GENERAL BOISDEFFRE TO TSAR NICHOLAS

"THE MOBILIZATION IS THE DECLARATION OF WAR. TO MOBILIZE IS TO OBLIGE ONE'S NEIGHBOR TO DO THE SAME.... OTHERWISE, TO LEAVE A MILLION MEN ON ONE'S FRONTIER, WITHOUT DOING THE SAME SIMULTANEOUSLY, IS TO DEPRIVE ONESELF OF ALL POSSIBILITY OF MOVING LATER; IT IS PLACING ONESELF IN A SITUATION OF AN INDIVIDUAL WHO, WITH A PISTOL IN HIS POCKET, SHOULD LET HIS NEIGHBOR PUT A WEAPON TO HIS FOREHEAD WITHOUT DRAWING HIS OWN..."

Figure 14

DETERRENCE TO REINFORCEMENT

IMPLICIT DANGERS OF REINFORCEMENT

- POLISH DIPLOMACY (DEPENDING ON THE ISSUES, UNITED COMMUNIST GERMANY, VS. POLISH GARRISON STATE ETC.)
- DANGER OF UPRISINGS

Figure 15

THE DUAL CAPABILITY PROBLEM

1. THREAT
   - A. MASSIVE SOVIET CONVENTIONAL ATTACK
   - B. SOVIET NUCLEAR STRIKE
2. MILITARY
   - A. DUAL MISSION
     - 1. DEFENSIVE
     - 2. OFFENSIVE
   - B. DUAL CAPABILITY
     - 1. CONVENTIONAL
     - 2. NUCLEAR
3. POLITICAL
   - A. REQUIREMENT FOR NUCLEAR WEAPONS RELEASE
   - B. THE LINE DIVIDING GERMANY
   - C. MONEY

Figure 16

SUGGESTED SOLUTIONS

1. MILITARY
   - A. DISPERSION
   - B. MOBILITY
   - C. DISPERSION AND MOBILITY
2. POLITICAL
   - A. NO BORDER ISSUE

Figure 17

HUDSON INSTITUTE SOLUTIONS

1. THREAT
   - A. MASSIVE SOVIET CONVENTIONAL ATTACK
   - B. SOVIET NUCLEAR STRIKE
2. MILITARY
   - A. SHIELDING EMPHASIS DEPLOYMENT
     1. LITTLE LOSS OF CONVENTIONAL CAPABILITY (OFFENSIVE AND DEFENSIVE)
     2. SIGNIFICANT NUCLEAR CAPABILITY
     3. CREDIBLE DETERRENT POSTURE
3. POLITICAL
   - A. NO REQUIREMENT TO COMMIT TO NUCLEAR WEAPONS RELEASE EARLY IN THE BATTLE
   - B. NO PRECRISIS BORDER ISSUE
   - C. NO EXPENSIVE OR DRASTIC CHANGES IN TO&E OF CURRENT NATO FORCES

Figure 18

BUNKER POSITIONING REQUIREMENTS

1. PREPOSITIONING
2. CARRY-ALONG KITS
3. SPECIAL EQUIPMENT FOR EACH COMPANY-SIZE UNIT

Figure 19

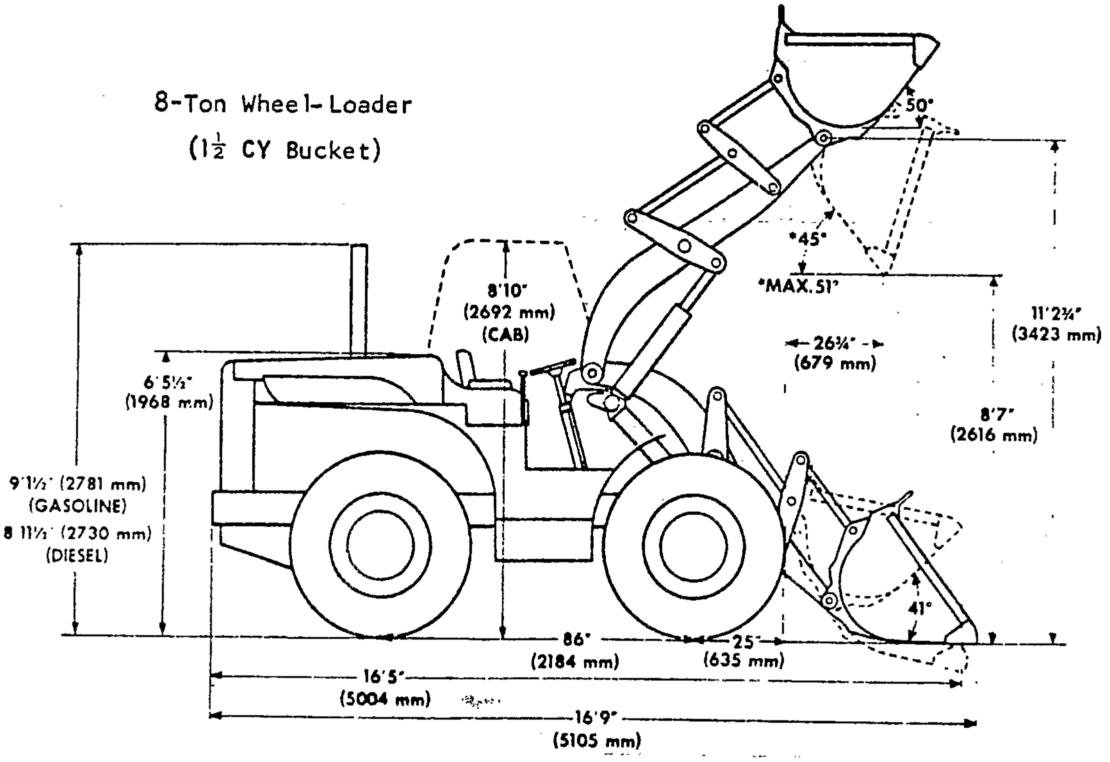
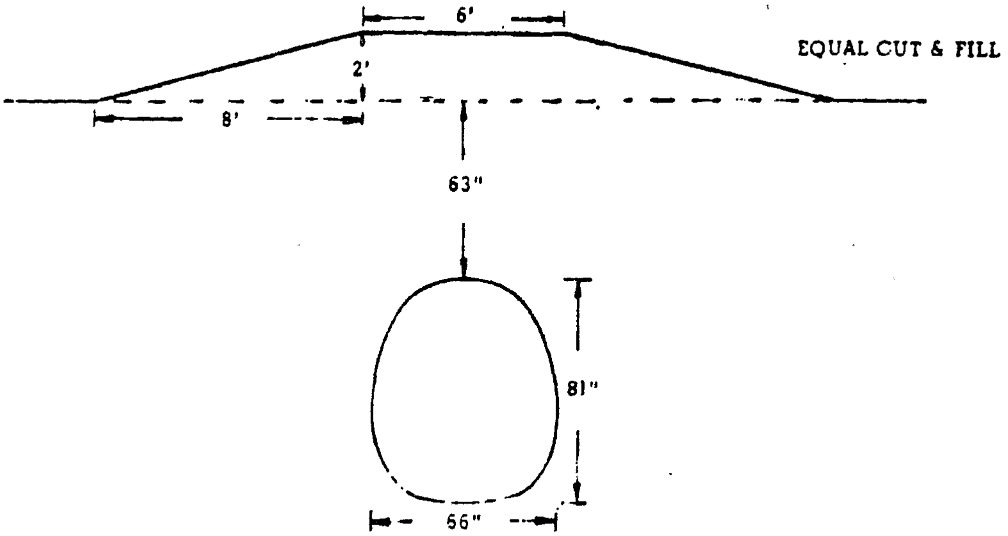
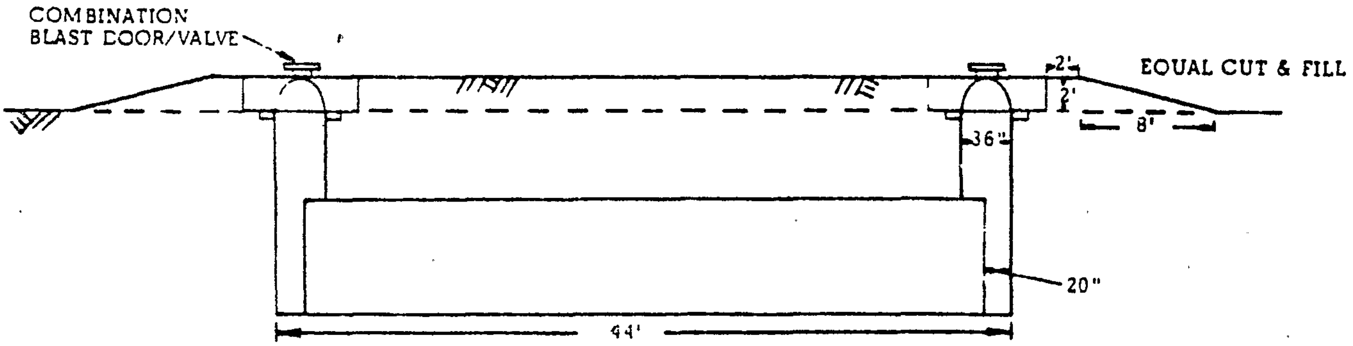

8-Ton Wheel-Loader
(1½ CY Bucket)
50°
*45°
*MAX.51°
11'2¾" (3423 mm)
26¾" (679 mm)
8'7" (2616 mm)
8'10" (2692 mm) (CAB)
6'5½" (1968 mm)
9'1½" (2781 mm) (GASOLINE)
8'11½" (2730 mm) (DIESEL)
41°
86" (2184 mm)
25" (635 mm)
16'5" (5004 mm)
16'9" (5105 mm)

Figure 20

CORRUGATED PIPE BUNKER
SCHEMATIC CROSS SECTIONS


6'
2'
8'
EQUAL CUT & FILL
63"
81"
56"

END VIEW

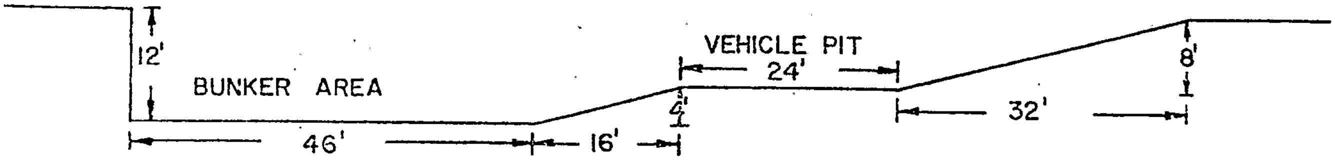

COMBINATION
BLAST DOOR/VALVE
2'
2'
EQUAL CUT & FILL
8'
36"
20"
44'

LONGITUDINAL VIEW
(HALF SCALE)

Figure 21

EXCAVATION FOR BUNKER AND VEHICLE PIT

LONGITUDINAL CROSS SECTION


12'
BUNKER AREA
VEHICLE PIT
24'
4'
8'
32'
46'
16'

PLAN VIEW

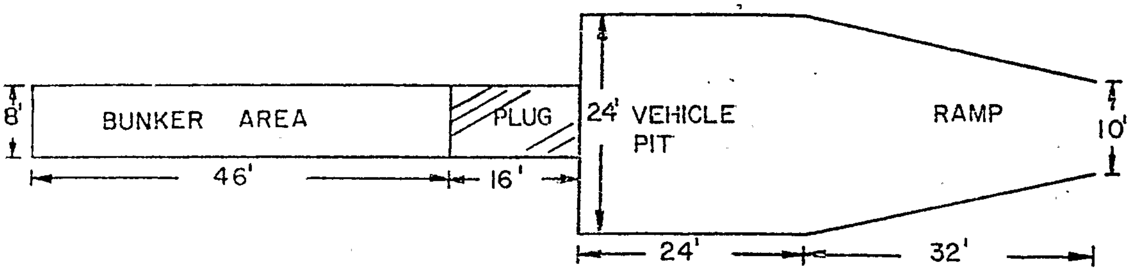

8'
BUNKER AREA
PLUG
24'
VEHICLE PIT
RAMP
10'
46'
16'
24'
32'

Figure 22

CROSS SECTION OF INTERIOR OF SAMPLE BUNKER

(LENGTH IS 40' PLUS ENTRANCE-EXIT PASSAGES)

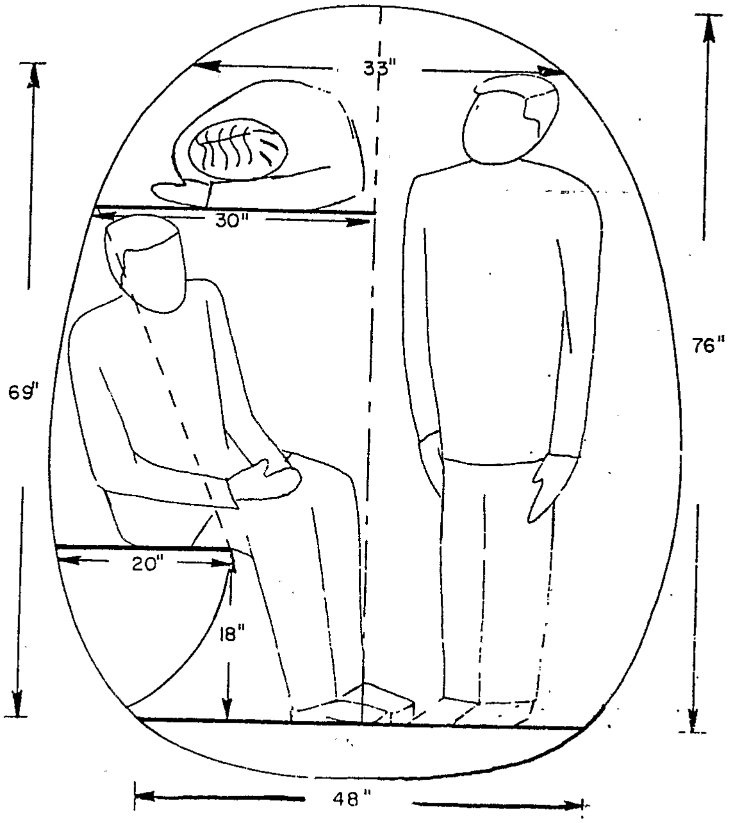

33"
30"
69"
76"
20"
18"
48"

Figure 23

BUNKER INSTALLATION FACTORS

1. TIME OF INSTALLATION
2. PROTECTION
3. COSTS

Figure 24

SAMPLE EMPLACEMENT TIME

SINGLE BUNKER

	W/L HRS.	MAN/HRS.	CONSEC. HRS.*
EXCAVATION & BACKFILL (INCL. VEHICLE PIT)	8-9	50-100	8-9
BUNKER ASSEMBLY & INSTALLATION		200-250	36
OTHER FORTIFICATIONS & PREPARATIONS FOXHOLES - MACHINE GUN PITS BARBED WIRE AND MINE FIELDS CLEARED FIELDS OF FIRE		200-250	72

WHOLE COMPANY (EIGHT BUNKERS)

	W/L HRS.	MAN/HRS.	CONSEC. HRS.
TOTAL EMPLACEMENT TIME	72-78**	4000-4800	72-78***

(Time Available Allowing for Patrolling and Other Functions.)

---

*12-Hour Shifts (Wheel-Loader on 24-Hours-a-Day Basis).

**Includes Travel Within Company Position.

***Since the Wheel-Loader Works on Only One Bunker at a Time, the Consecutive Hours Required for the Company is Greater Than the Consecutive Hours Required for Any One Bunker.

Figure 25

THEORETICAL BUNKER VULNERABILITY

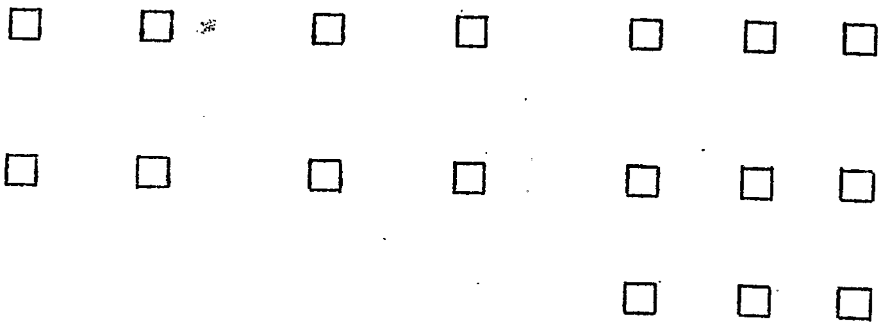
SEPARATION 1200 METERS
80 PSI; 2200 P.F.

Figure 26

YIELD	NUMBER OF BUNKERS KILLED
UNDER 100 KT	1
100-250 KT	2
250-2500 KT	4
OVER 2500 KT	9

ALTERNATIVE AIMING POINTS

TO KILL TWO BUNKERS	TO KILL FOUR BUNKERS	TO KILL NINE BUNKERS



KILL DISTANCE AT LEAST ½ SEPARATION BETWEEN BUNKERS	KILL DISTANCE AT LEAST .7 TIMES SEPARATION BETWEEN BUNKERS	KILL DISTANCE AT LEAST 1.4 TIMES SEPARATION BETWEEN BUNKERS

Figure 27

CORRUGATED PIPE BUNKERS
(80 PSI PF 2200)

COST ESTIMATES

PIPE--40 FEET	$1500	
ENTRANCES--2, INCLUDING BLAST VALVES	1000	
COST FOR STRUCTURE		$2500
BUTTON-UP (O_2-CO_2) SYSTEM @ ¢10/PERSON	250	
VENT BLOWER (HAND & MOTOR)	50	
GENERATOR	350	
HABITABILITY ITEMS	650	
MISCELLANEOUS ITEMS (TOOLS, EXPLOSIVES, PHONES, INSTRUMENTATION, PERISCOPE, DRAINAGE)	400	
		1700
DIGGING EQUIPMENT (1/8 OF AN 8-TON, 1.5-CY WHEEL LOADER)		2500
		$6700

APPROXIMATE TOTAL WEIGHT--8000 LBS.

FOR SEVENTH ARMY--2500-3000 BUNKERS @ $6000-8000
TOTAL--$15,000,000-24,000,000

Figure 28

A. DIVISION FRONT APPROXIMATELY THAT CURRENTLY DESIGNATED BY NATO FOR DISPERSED DIVISION.

B. SURVIVABILITY UNDER TACTICAL NUCLEAR ATTACK.

Figure 29

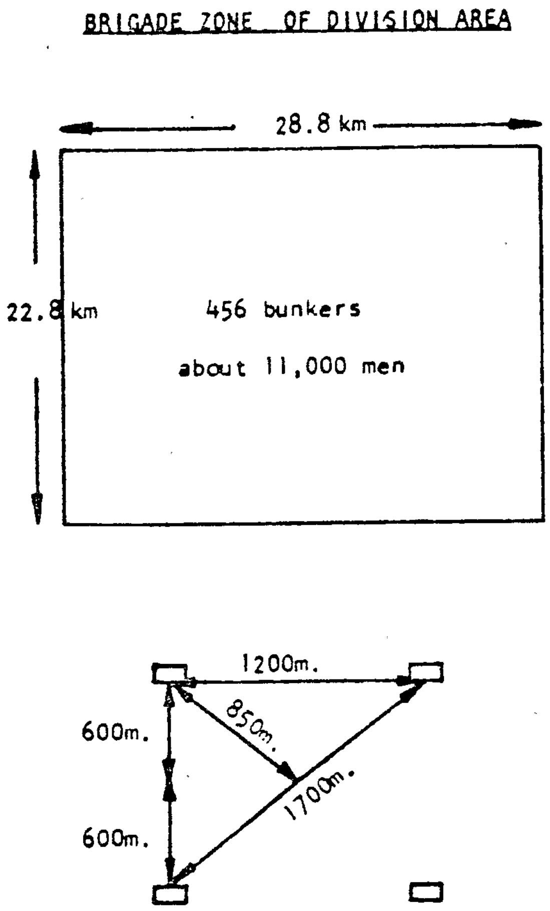

BRIGADE ZONE OF DIVISION AREA
28.8 km
22.8 km
456 bunkers
about 11,000 men
1200m.
850m.
1700m.
600m.
600m.

Figure 30

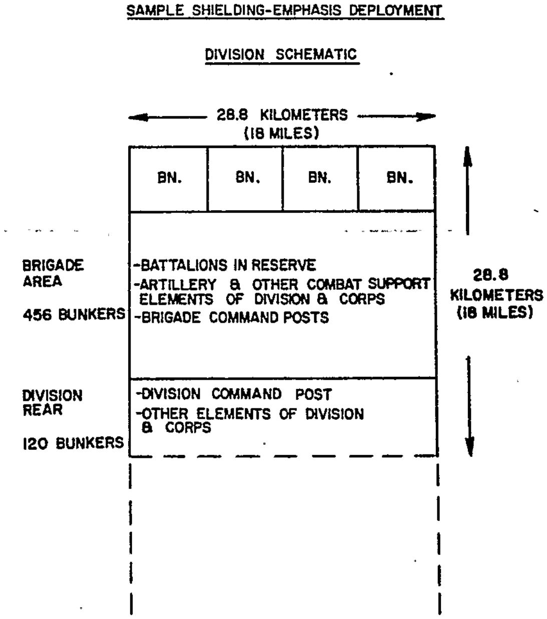

SAMPLE SHIELDING-EMPHASIS DEPLOYMENT
DIVISION SCHEMATIC
28.8 KILOMETERS (18 MILES)
BN.
BN.
BN.
BN.
BRIGADE AREA
456 BUNKERS
-BATTALIONS IN RESERVE
-ARTILLERY & OTHER COMBAT SUPPORT ELEMENTS OF DIVISION & CORPS
-BRIGADE COMMAND POSTS
28.8 KILOMETERS (18 MILES)
DIVISION REAR
120 BUNKERS
-DIVISION COMMAND POST
-OTHER ELEMENTS OF DIVISION & CORPS

Figure 31

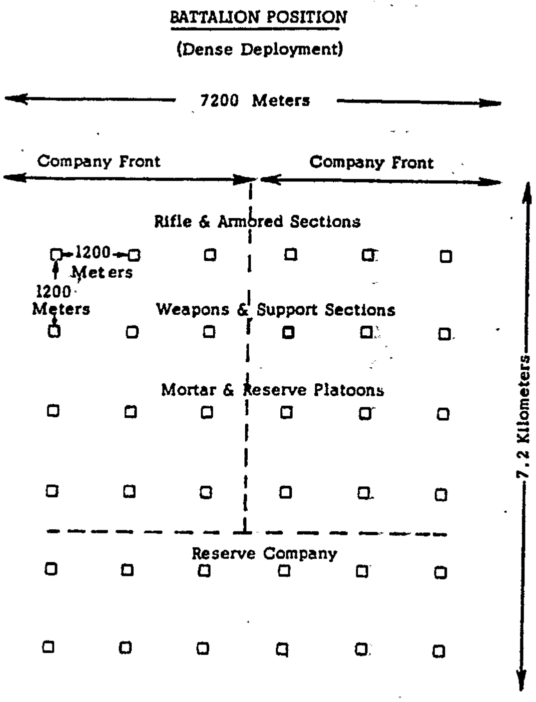

BATTALION POSITION
(Dense Deployment)
7200 Meters
Company Front
Company Front
Rifle & Armored Sections
1200 Meters
1200 Meters
Weapons & Support Sections
Mortar & Reserve Platoons
Reserve Company
7.2 Kilometers

Figure 32

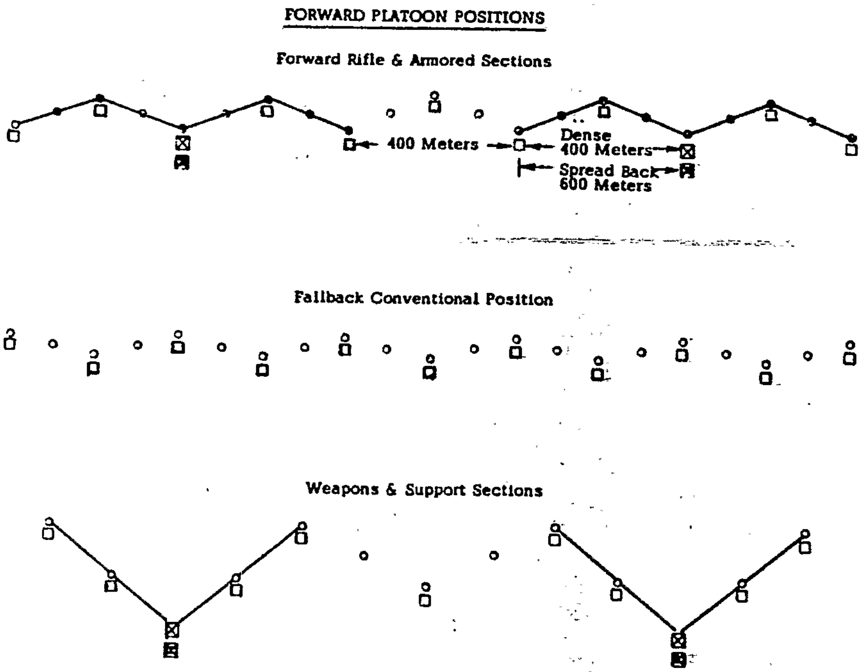

FORWARD PLATOON POSITIONS
Forward Rifle & Armored Sections
400 Meters
Dense
400 Meters
Spread Back
600 Meters
Fallback Conventional Position
Weapons & Support Sections

Figure 33

FORWARD SECTION POSITION

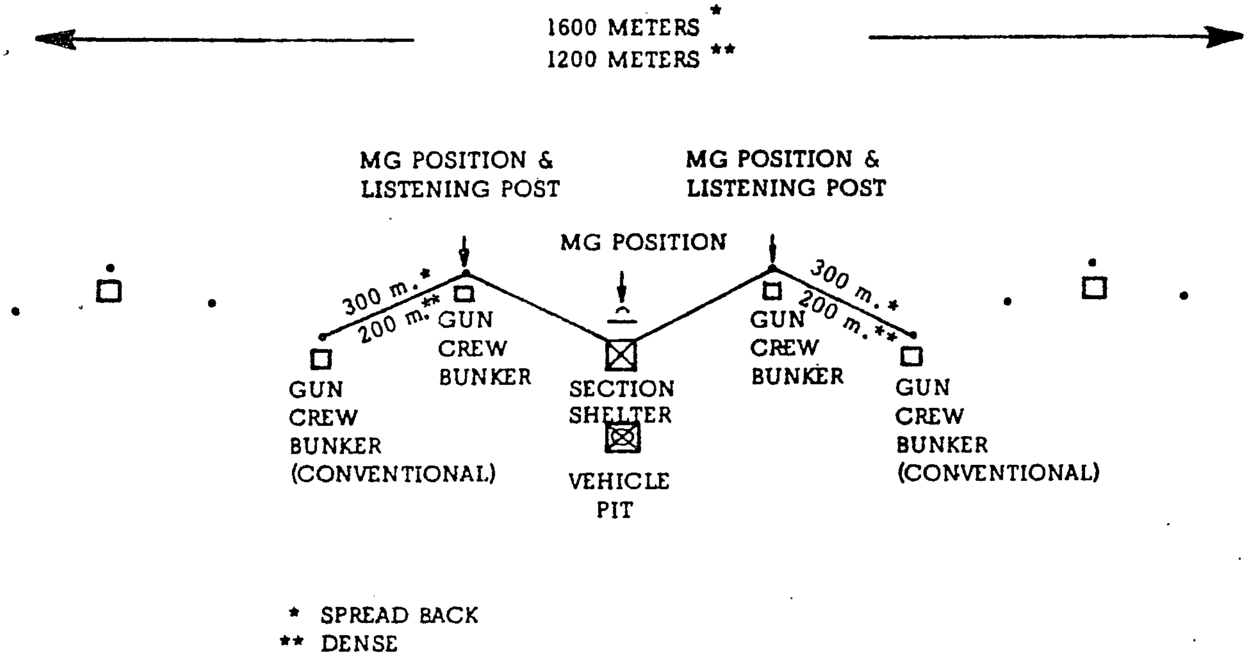

1600 METERS *
1200 METERS **
MG POSITION & LISTENING POST
MG POSITION & LISTENING POST
MG POSITION
300 m. *
200 m. **
300 m. *
200 m. **
GUN CREW BUNKER
GUN CREW BUNKER
GUN CREW BUNKER (CONVENTIONAL)
GUN CREW BUNKER (CONVENTIONAL)
SECTION SHELTER
VEHICLE PIT
* SPREAD BACK
** DENSE

Figure 34

COMBAT OPERATIONS

1. KNOWN LOCATION OF ONE'S OWN TROOPS.
2. SUPERIOR COMMAND AND CONTROL ENVIRONMENT.
3. CONTINUOUS CONVENTIONAL FRONT OR NUCLEAR PICKET LINE.
4. SECTIONS RETAIN THEIR NORMAL MOBILITY AND FIREPOWER
5. UNITS CLOSE AT HAND FOR MASSING FOR EITHER LOW- OR HIGH-LEVEL CONVENTIONAL DEFENSE OR OFFENSE.
6. LESS REQUIREMENT FOR NUCLEAR WEAPONS AT LOW LEVELS OF COMBAT AND WHILE BATTLE IS DEVELOPING.
7. MINIMUM EXPOSURE TO ENEMY NUCLEAR THREAT BEFORE AND DURING OFFENSIVE AND DEFENSIVE DEPLOYMENT AGAINST CONVENTIONAL THREAT.

Figure 35

Question and Answer Period

COWAN (3rd Armored Div.): For the past two years, it has been my job at SHAPE Headquarters to assess the capabilities of NATO forces versus those of the Warsaw Pact. I realize, Mr. Armbruster, that the information which may be available to you at this particular time is not current, but I am afraid I must take issue with you on your assessment of the Warsaw Pact forces and the US forces. I would suggest that you read MC161/69, which is the current agreed NATO intelligence for the Warsaw Pact. Even MC161/68 would have given the Soviets a greater capability than you have given them. For example, in the '68 studies, we at SHAPE assessed the Soviet forces at about 145 divisions; we deployed these divisions throughout the Soviet Union based on what one could consider their war plans, and it indicated a considerably greater concentration of troops in the central region than you have given.

Secondly, with regard to US forces, the 7th Army no longer exists. We have five divisions in Europe, organized into two corps under the command of the US Commanding General, US Army Europe. Since I am now the Assistant Division Commander of one of the armored divisions which you have on that chart, I can say that we are not at full strength either, and we are short of officers as well as enlisted men. We have, in my division, at the present time, about 50 percent of the officers authorized, and the important fact is that we do not have the mature field grade officer—in a battalion, we go from a lieutenant colonel down to a lieutenant, both on the staff; we have one or two officers per company, and if a man is promoted to captain he immediately goes to Vietnam.

The third point I'd like to make is this: With regard to the dual capability dilemma, I want to use the Air Forces as an example. In NATO, we are using a family of aircraft developed over the years. The principal aircraft being used is the 104G. We have talked about changing our conventional strategy and have politically said that we can do this. Resources required to convert a force which was organized in the 1950's, and continued primarily as a nuclear capable force, to a conventional arms force requires much more than either our NATO Allies and, I am afraid, the United States, are putting forth in Europe today. To convert, for example, the F104G to a conventional delivery capability requires a considerable amount of money. At the present time our NATO Allies consider the cost too great. I am afraid you will find that, in NATO, the United States is the only country that has a dual capability Air Force.

In summary, I would like to say the following: Gentlemen, in Europe, within the last few years, there have been significant political, economic, and military changes. I am afraid that we in the United States who are involved in planning and study have failed to realize these changes, and we are being unfair to ourselves by not making a greater attempt to get the facts.

ARMBRUSTER: Thank you, General Cowan. Are you taking issue with the number of Soviet divisions that I put in Western USSR and in European USSR? And you say there are more than 75 Soviet Divisions in Western USSR?

COWAN: Yes, the figures run about 85 as I recall them. I am sorry I don't have my own papers here. Actually by deploying them in the military districts and utilizing them, Categories I, II, and III, as they are categorized in the MC161/68 and 69, you will find that they run about 85 divisions that he could move in; and MC161/69 raises the overall capability from 145 divisions to about 161.

ARMBRUSTER: Not within a 600-mile rim though. You are speaking of territory as far east as the Urals.

COWAN: I am talking about the employment of Soviet divisions out of the western portion of the USSR that can be deployed in a central attack against NATO. This also includes and commits some 14 divisions against Norway, some 13 divisions against Italy, some 17 against the Bulgarian front, and another 17 in Eastern Turkey.

ARMBRUSTER: I see. I think the General's point is well taken, because in my statement for Western USSR I was talking about Belorussia and the area as far east as the Moscow line to the Yasinovataya, not the divisions east of the Moscow line or the northern units. These are more than 600 miles away. It takes a longer time to get them in.

RUSSELL (Hq., Dept. of the Army): Skipping the first portion where you developed the holding forces and so forth, and into the second, I believe your study was directed mainly at developing a rationale for having a rapid emplacement capability for fortified bunkers or similar emplacements. I'd just like to point out that for several years we have been investigating this type of structure, and I believe your figures are somewhat conservative, that we can put them in faster and cheaper and have a much wider range of possible material already evaluated. I can come up with designs which could be used on very short notice.

ARMBRUSTER: I don't doubt that. As I said before, what I was doing was taking stuff from corporations which I am sure you could do a lot better.

RUSSELL: I am just saying that I believe your figures of $56,000 apiece, and several days to put them in, are conservative. You should be able to put them in with hand shovels and readily available explosives.

ARMBRUSTER: I defer to the engineer.

SQUIRES (LRL): I wonder if you'd like to extend your comments about vulnerability to a nuclear strike to the vulnerability of our present posture in the peacetime casernes. This kind of idea might be extended to protecting them.

ARMBRUSTER: Protecting them in the casernes?

SQUIRES: Yes, in our present peace time posture.

ARMBRUSTER: Again, we haven't looked into this, so I can't give you a definite answer; but actually the concentration of troops is so heavy there that it might be worthwhile to fire at these casernes even if they are hardened. I don't know how you could harden them sufficiently to withstand direct fire. I may be wrong on this, but the forces are really concentrated heavily in some of these areas—I would not want to try to make shelters for them, particularly since I would assume they would have to be deployed if they are going to be useful in a time of crisis.

General David A. Burchinal
Hq., US European Command

QUALITATIVE NUCLEAR WEAPONS REQUIREMENTS FOR ALLIED COMMAND EUROPE

It is a real pleasure for me to attend this symposium, renew old friendships and, further, to share with you some personal views concerning tactical nuclear weapons. This symposium comes at a particularly opportune time; actually, it's long overdue.

During the last several years we have made almost no progress toward satisfying our real and pressing requirements for improved tactical nuclear weapons. In the last five years only one improved tactical weapon, the Mk 61 bomb, has entered the stockpile. We who are concerned with trying to make deterrence continue to work for us and for Allied Command Europe have noted a steady erosion in tactical nuclear capabilities, and there are now serious qualitative deficiencies in our stocks of weapons. I will talk about these qualitative requirements a bit later, but I would first like to focus briefly on the threat environment we work in, our capability to counter this threat and, in this context, what is on the books as NATO strategy and some of our options (see Figure 1).

Contrary to the public statements and euphoric daydreams of some US and European theorists, the threat to ACE has in no way abated over the past years, and we see no signs that point toward a reduced threat in the future. Just the reverse is true.

The Warsaw Pact military threat to ACE is composed of strong, flexible, well-balanced ground, air, and naval forces. These are deployed well forward and are particularly concentrated against the central region of Europe. As a result of this forward stationing on or near NATO borders, the Pact is today in a position to attack with little or no warning. The Soviets might choose, of course, to deploy additional forces first, under cover of exercises, or they might even mobilize; they did both last summer in preparation for Czechoslovakia.

NUCLEAR WEAPONS
IN
ALLIED COMMAND
EUROPE

Figure 1

Pact theater forces located and probably earmarked for operation against the critical central region of ACE constitute about 60% of the total Pact forces (see Figure 2).

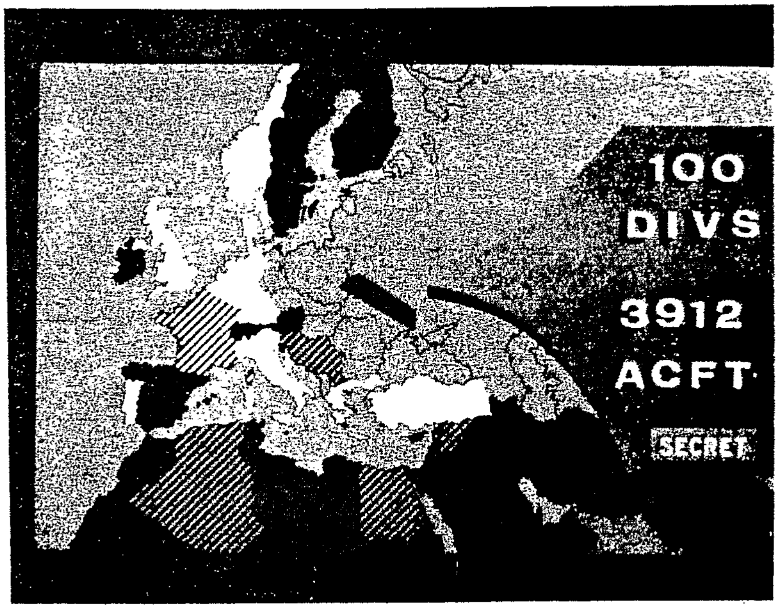

100
DIVS
3912
ACFT
SECRET

Figure 2

The Soviets have made significant improvements in their general-purpose forces over the past five years; among these are the introduction of new and improved weapon systems such as the FROG 7, a new wheeled vehicle for SCUD B, improved FISHBED aircraft (F&H), and guided missile equipped helicopter ships (see Figure 3).

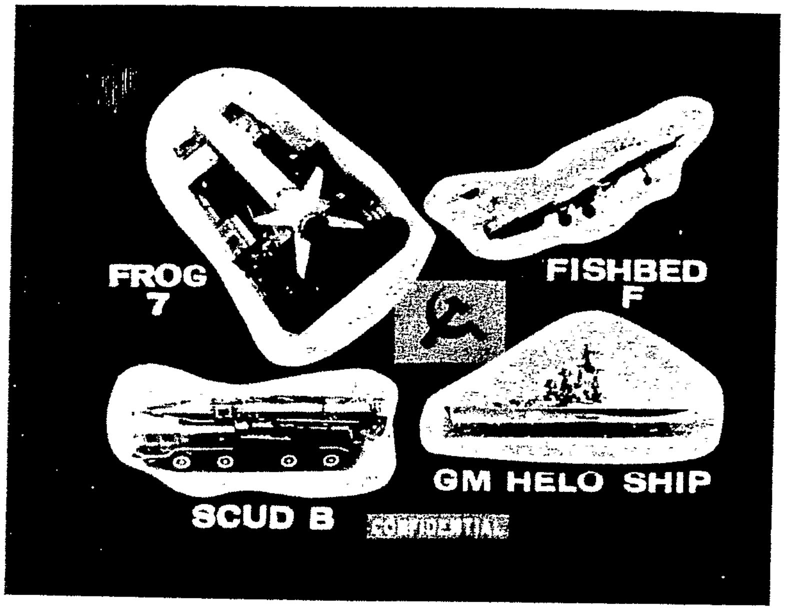
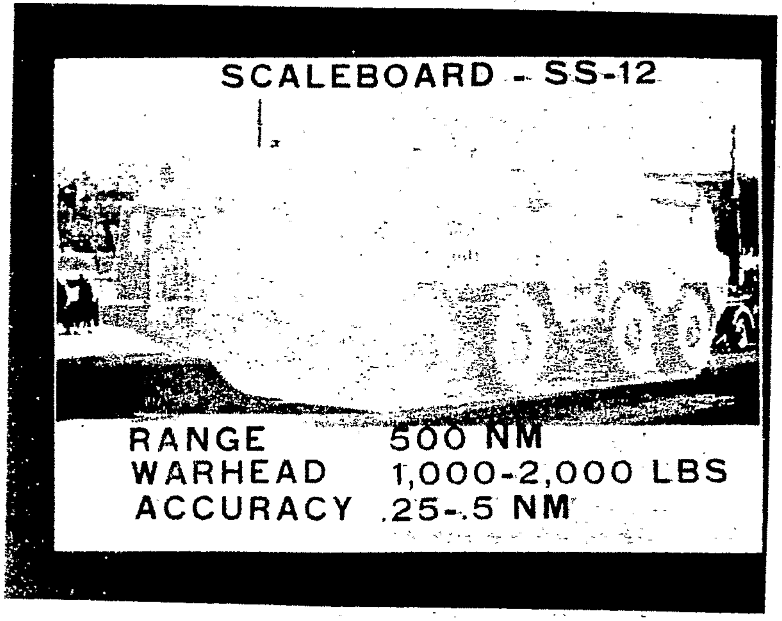


Figure 3

The Soviets have paraded and apparently initiated deployment of a road mobile missile system, which we call SCALEBOARD (see Figure 4).


SCALEBOARD - SS-12

RANGE 500 NM
WARHEAD 1,000-2,000 LBS
ACCURACY .25-.5 NM

Figure 4

At present, the missile associated with the SCALEBOARD, the liquid fuel SS-12, has an estimated range of about 500 nm, and thus would be considered as a short-range tactical support system. However, the Soviets have stated that this missile has a range of "thousands of kilometers," and units of this type missile are subordinate to the strategic rocket troops. Therefore, there is a possibility that the SCALEBOARD or a version of it is an MRBM.

While the Soviets continue to recognize the essentiality of strategic attack and defense forces and are investing heavily in them, they now show increasing interest in improving the capabilities of their general-purpose forces to meet contingencies short of general nuclear war. This interest seems to be in part a response to past developments in US and NATO capabilities, to US advocacy of flexible response, to some restiveness on the part of their East European partners in the Warsaw Pact, as well as persistent Chinese hostility.

The Soviets formerly assumed that any general war with NATO would begin with a massive nuclear exchange, and planned that, in the aftermath of such an exchange, their forces would advance rapidly to seize critical objectives before NATO forces could recover from the destruction and disorganization caused by nuclear strikes. In recent years, however, Warsaw Pact military exercises have been using a significantly different scenario, based on the assumption that war with NATO would be preceded by a period of high tension, providing sufficient warning to permit the mobilization and deployment of Pact forces. The war would begin with a NATO conventional attack. Warsaw Pact conventional forces would defeat this attack, causing NATO to resort to the use of tactical nuclear weapons. Then the Pact forces, reinforced from the USSR and using nuclear weapons, would launch a counteroffensive that would overrun NATO Europe. It is particularly notable that no strategic nuclear exchange is taken into account in this scenario. We believe that these recent exercises are indicative of Soviet emphasis on developing capabilities to wage war in Europe using conventional weapons to the maximum extent.

Soviet doctrine concerning conventional wars has recently been modified. Until the early 1960's, they dismissed the possibility of such wars between major powers, holding that nonnuclear wars would almost certainly escalate. In a July 1967 article, Marshal Ivan Yakubovskiy—Soviet First Deputy Minister of Defense and Commander of Warsaw Pact forces—confirmed that flexible response is now accepted Soviet military doctrine. The article does not appear to be a call for more conventional forces; rather, it confirms the Soviet position on a balance of nuclear and conventional forces to meet the requirements for both nuclear and nonnuclear war.

This, then, is, in general terms, the doctrine which places the nuclear threat to ACE in a perspective, particularly as it affects the central region. This threat has not moderated over the last 20 years but, rather, has become more varied and more intensive as the Soviets come to grips with some of the same problems as those that concern us in ACE.

Now let's consider our strategy and capabilities to respond to this threat.

Following the formation of NATO in 1949, the military strategy of the Alliance relied heavily on the nuclear weapon deterrent power of the United States and the United Kingdom. This was called by some the "Trip-Wire" philosophy, and it embodied the concept of immediate NATO nuclear retaliation to major Soviet/ Warsaw Pact aggression. This strategy was formally set out in a NATO Military Committee document, MC 14/2, issued in 1957.

In May 1967, the NATO defense ministers, in defense planning committee session (that is, without France, or what is sometimes called "The Fourteen"), adopted, at the urging of the United States, a new "Political Guidance" directive for NATO.

This 1967 decision was a "key" one, since it is now the basic political guidance for the development of all NATO military plans.

This revised guidance adopted by the defense ministers highlighted several significant propositions for military planning.

The defense ministers did not ignore the possibility of major aggression, but indicated that the threat was moderated.

Secondly, the ministers gave the military authorities planning guidance to the effect that political tension of several weeks, if not months, would precede aggression—and give us warning of attack. It is fair to say that the military in Europe accepted this judgment reluctantly, and there is now growing concern in political circles with the validity of trying to use political indicators (which everyone agrees may exist in any situation) as a substitute for usable military warning, or as a reliable motivation for timely political decision.

Thirdly, the ministers told the NATO military authorities to base their force planning on level, or declining, defense budgets, and this at a time when all Pact nations were showing significant increases in their defense budgets. In effect, the defense ministers were directing SACEUR (and SACLANT) to do more with less, and to do it in a political environment of detente and declining defense budgets.

One of the centerpieces of the defense ministers' meeting in Brussels four months ago was a re-examination of this 1967 guidance in the perspective of the Czech invasion and other political-military developments. By and large, we think the results of that session somewhat more realistic; at least the agreed words and papers point in the right direction.

In discussing the threat last May, the ministers did take note of increased Warsaw Pact capabilities.

The notion of political warning was affirmed, although the dangers of too heavy reliance on it were acknowledged. This was a welcome shift in emphasis.

The key operative passage addressed in this review of the 1967 guidance—at least as far as we were concerned—was the question of defense resources. The Allies resisted acceptance of a 4-percent figure as a stated goal for real increases in defense budgets in the 1971-75 period. They did agree, however, that force proposals for the period should be based on the assumption of a "moderate overall rate of increase in currently planned defense expenditure on NATO account . . ." Whether the nations provide the increases remains to be seen, but the new resource guidance is at least a welcome change from the prognosis made in May of 1967.

Regarding strategy, the need for flexibility in military responses was soundly reaffirmed.

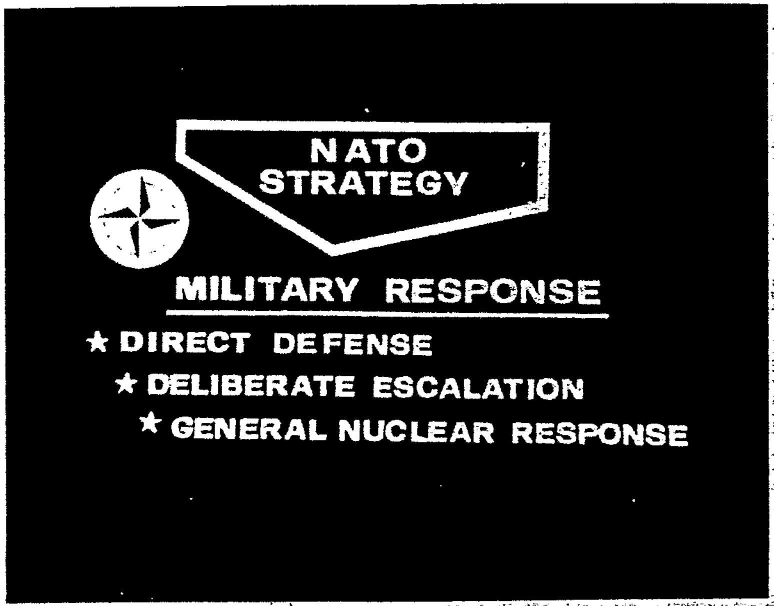
While the political guidance of two years ago has thus been modified, the changes do not alter NATO's current strategic doctrine. This strategic concept derives from the attempt to provide the flexibility of military response which the ministers called for in 1967 and reaffirmed just last May. It was formalized by the military committee in a document called MC 14/3, approved in December 1967. To carry out that newly enunciated strategic guidance, SACEUR last year made extensive revisions in his emergency defense plan. Some of the key elements of the directed strategy are:

a. Its emphasis on deterrence to any level of aggression;

b. Its incorporation of the notion of political warning time; and

c. Its formal adoption of a doctrine popularly—if somewhat inaccurately—called "flexible response." Incidentally, General Lemnitzer did not like the description of NATO's strategy as "flexible response," saying it connotes gradualism, and he would not use the phrase.

The 1967 concept envisions three types of military response open to NATO, as listed in Figure 5.



NATO STRATEGY

MILITARY RESPONSE

- ★ DIRECT DEFENSE
- ★ DELIBERATE ESCALATION
- ★ GENERAL NUCLEAR RESPONSE

Figure 5

One or more of these courses could be used to meet any specific contingency. The strategy requires that the direct defense response be appropriate to defeat aggression on the level at which the enemy chooses to fight, with deliberate escalation an option if an attack cannot be contained through direct defense. Direct defense, as used here, is substituted for forward defense, and while NATO planners insist that it will occur as far forward as possible, there is some inference that geography may have to be traded for time. It is important to note that nuclear weapons are not ruled out and might be used in executing any of the responses listed here.

While not ruling out the use of nuclear weapons, implementation of the revised strategy does require improved conventional means. To implement the appropriate response feature of the NATO strategy, it is obvious that competent and sufficient conventional forces are required, and almost equally obvious that they are not now in being. The analysis of how competent and what is sufficient obviously involves some highly subjective value judgments.

When we look at ACE strategy and the forces available to execute this strategy, then compare these with Warsaw Pact forces and capabilities, we find little comfort. In order to successfully execute this strategy in the face of superior odds, the use of tactical nuclear weapons might have to be considered very early in the conflict. As General Lemnitzer stated to the NATO military committee, in one of his final appearances as SACEUR, "Conventional combat for more than a short period would not be possible. We are faced with hard, concrete, serious logistics deficiencies which will prevent a sustained conventional defense, not just limit it."

Various nuclear options are open to ACE, which in turn dictate the types of nuclear weapons that we require. As I discuss these options, keep in mind the basic and all-important fact that SACEUR's mission and strategy are defensive.

In demonstrative use of nuclear weapons, which is, incidentally, a popular subject today for study by the NATO nations, political objectives would clearly dominate the military ones. The aim would be to demonstrate NATO's willingness and determination to resort to nuclear weapons if necessary, and thereby dissuade the Soviets from further military actions.

The target for a demonstration might be selected to eliminate or minimize risk to enemy or friendly forces or civilian populations or to destroy a military target. The military or tactical effect of the strike, however, is likely to be a secondary consideration.

By selective release, I refer to the use of nuclear weapons—one or a few—in a given situation to respond to a specific threat. In terms of current Alliance strategy, the selective release option might well be the first one that NATO would have to face in a real war; and it's precisely the first-use situation that could be the most difficult from a political point of view.

The political judgments, of course, involve very substantial issues, and aren't made any easier by the fact that in NATO the "Selective Release" consideration and decision may well be discussed in multilateral forums—this was established in the famous Athens Guidelines of 1962 and reviewed by the NATO Nuclear Planning Group earlier this year in London. As you can imagine, the Scandinavians might well take a different view than would the Greeks or Turks, of whether a deteriorating military position (in the Thrace area, for example) required selective nuclear release.

The option of using nuclear weapons under a set of limitations or political restraints doesn't fit the demonstrative option. It refers, as an option, to a more advanced stage of tactical nuclear warfare where weapons might be used with constraints or limitations by kinds of weapons, classes of targets, or geographic areas.

I think there are some advantages and some dangers in these kinds of restraints. One can, by setting up nuclear rules of engagement, perhaps facilitate the timely release of certain kinds of nuclear weapons to enhance their military value. Atomic demolitions and antisubmarine and air defense weapons come to mind in this regard. Their characteristics and method of employment make them pretty clearly distinguishable from, say, strikes by artillery shells and aerial bombs. On the other hand, limitations on kilotonnage to be applied, or on the kinds of hostile installations that may be struck, probably have value only in a very gross way. We certainly can't go much beyond the nuclear threshold with any assurance that the enemy can get the message we are trying to convey, or to make refined readings of the pattern of our nuclear attacks or, for that matter, that he can recognize that our strikes are limited to warheads of less than a certain kt, or that we're minimizing damage to population centers. These kinds of criteria may have important humanitarian, psychological, and political justification on our side; it could be fatal, however, to believe that the enemy can be relied on to reciprocate with corresponding restraints.

It might be feasible to gain some political advantage from geographical constraints. Here I refer to such possibilities as withholding strikes against selected Warsaw Pact satellites, to achieve the political and military aim of their getting out or staying out of the fight. Determining the utility of exercising this kind of restraint requires a first-class crystal ball, much better than our current model, and achieving the desired aim would require a coordinated political-psychological-military campaign. Some carefully drawn and reliable counteractions must be planned to reduce the possibility of a disastrous mistake by the Pact if they should use the initiative we've passed to them in such an action/counteraction game.

The general-use tactical nuclear option—that is, the unlimited theater nuclear option—is a difficult one in which to find a consensus. Some might define it as a brief moment on the way to a full-scale strategic nuclear war, a way that we destined by the first selective release. Others might argue that general use of tactical weapons without political approval in each case or class of cases would never be allowed, and thus there is no "general-use" option. A third group might argue that widespread tactical use of weapons represents a possible alternative to full-scale nuclear warfare and, as such, is a distinct controllable step on the ladder of escalation. Finally, one could argue persuasively that this option is no longer available to us with our existing tactical weapon systems, and that this escalatory option is one where ACE is at a disadvantage.

DOE
6.2(a)

DELETED

The use of nuclear air defense weapons to defend naval forces provides a good illustrative example. To allow for timely reaction by a carrier task force to a major air attack, the commander might be authorized to resort to nuclear air defense means, under specific and prescribed conditions, if the survival of his force is at issue, and, in his judgment, the prescribed conditions are met.

Summing up these nuclear options, I'd stress these characteristics of the nuclear policy environment in which we live:

a. The multilateral political desire for involvement in the nuclear decision-making process is very great, and will remain so.

b. Military and political considerations in the use or non-use of tactical nuclear weapons more often tend to contradict each other than to coincide.

c. The political impact of our nuclear options depends on what the enemy thinks, and we must be careful that we're not substituting our attitudes for his when we assess our options.

d. Finally, there is a large risk of deluding ourselves and/or paralyzing our capability to act by overstructuring and excessively refining the nuclear decision process.

With this background, let us now turn to the types of tactical weapons systems we feel are required to support SACEUR's mission.

First, let's consider field army support systems. There is no question in our minds that the area most needing improvement in ACE is support of the land battle. Over half of the weapons currently allocated to USCINCEUR are over a decade old and represent, at best, the technology of the mid-1950's. They are rapidly becoming antiquated and obsolescent. These weapons include the Honest John, Nike Hercules, and 8-inch howitzer, all of which are used by both US and non-US forces. We question how long our NATO Allies will be willing to support weapons systems which obviously do not represent the current state of the art. In fact, we have already seen signs that they will not support them. Last April, the FRG reduced by 25% the number of Honest John launchers in their force structure. Among the reasons cited for this action was the obsolescence of the system. Nike Hercules falls into the same category; it was introduced into the US inventory about 12 years ago, yet our program in ACE is still incomplete, for various reasons, and may never be complete. As the types and capabilities of Pact forces increase, the Nike Hercules will become more and more ineffective, and yet there is no nuclear surface-to-air munition in later stages of development to replace it. SAM-D is mentioned as a replacement, but we see no action to make us believe it will be available in the next five years. We cannot effectively counter today's threat, let alone the future threat, with yesterday's weapons. Falcon, the only nuclear capable air-to-air missile in ACE, is phasing out as F-4 aircraft replace the F-102.

We need improved air defense systems, both surface and air launched, to better our defensive posture (see Figure 6). We need to move out in developing SAM-D or a comparable system, and at the same time develop an air-to-air missile to replace Falcon. We also need a replacement for Terrier and Talos, which I'll discuss later.

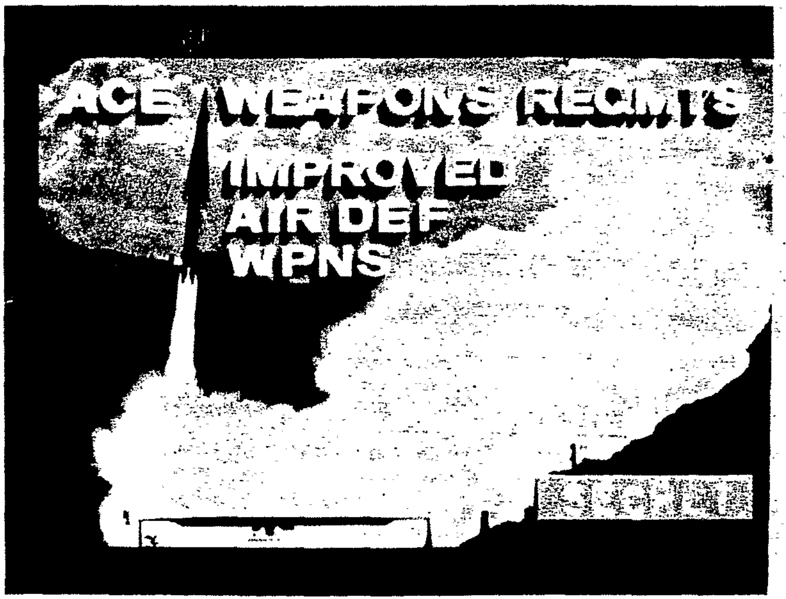


Figure 6

The 8-inch howitzer (see Figure 7) is an accurate, responsive, and necessary system, but it presently has warhead limitations. The current warhead requires extensive preparation, which obviously reduces its responsiveness. DELETED We need a warhead with unlimited shelf life, and little or no maintenance required, and one that can be easily destroyed or rendered useless in an emergency. We also need a cheap round, which admittedly is somewhat of a paradox. It is, however, a fact of life that future qualitative improvements will have to be achieved with economy in mind. Nonetheless, if we really mean to improve our capabilities to counter the threat, then we must be willing to pay the price.

DOE 6.2(a

We also believe that improvement in the 155 mm howitzer (see Figure 8) nuclear round is required. The 155 is an extremely valuable system because of its mobility, responsiveness, and ability to provide accurate, close-in nuclear support. It is the backbone of our division fire support. It has, however, a yield limitation at the present time which decreases the types of targets it can effectively engage.

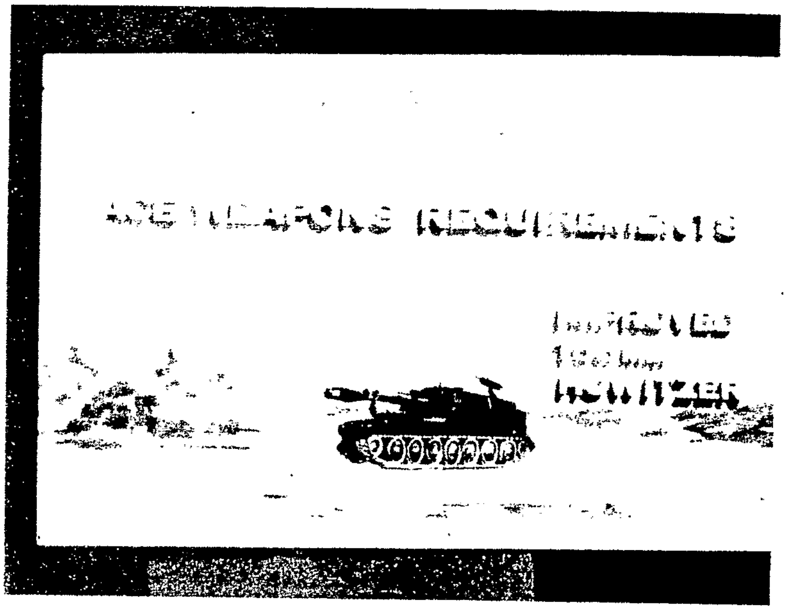
DOE 6.2(a)

DELETED

AEC WEAPONS REQUIREMENTS

IMPROVED
[illegible]
HOWITZER

Figure 7



AEC WEAPONS REQUIREMENTS

IMPROVED
155mm
HOWITZER

Figure 8

I think it is apparent that the success of ACE's defensive strategy is dependent upon being able to delay and contain a Warsaw Pact attack as far to the east as possible until such time as ACE can reinforce its engaged forces. In large measure, this delay will be dependent upon the successful implementation of barrier plans. Present barrier planning envisions the use of great masses of materials. For example, the Seventh Army barrier plan alone requires 535,000 antitank mines, over 2 million antipersonnel mines, 1.3 million feet of detonating cord, and many tons of miscellaneous other material including almost 60,000 km of barbed wire. This material must be moved by train from depots west of the Rhine River to the vicinity of emergency defense positions, which requires the use of up to 16 trains and will take about 90 hours. Barrier planning also envisions the use of ADM's (see Figure 9), but sufficient conventional barriers must be maintained to accomplish the mission should ADM use not be approved. The logistics of this requirement are staggering. Present ADM planning is limited by the character of available ADM's. Today's ADM's possess no rapid burial means; thus, surface bursts must be employed, since insufficient time would be available to prepare holes for ADM's. True optional employment is lost—or could be. Surface use of ADM's is undesirable, as it results in unwanted collateral effects, provides less than optimum obstacles, and necessitates the use of a higher yield than would be required if burial were possible. We need some rapid means of burying ADM's and, along with that, ADM's designed to withstand optimum burial.

ACE WEAPONS REQUIREMENTS
IMPROVED
ADM

Figure 9

We need a better ADM, one which accurately reflects the current state of the art, one which eliminates the present undesirable features. It should have selectable yields, with the higher yields incorporating suppressed radiation. It must be lightweight and man-transportable. It must be capable of deep burial for extended periods of time. Further, it must possess a remote, wireless command and control capability, responsive to direction by surface or airborne commands at extended distances. This same command and control capability must extend to the permissive action link device. Finally, the ADM should contain antitampering devices and a nonnuclear self-destruct capability.

While a barrier planned around the use of ADM's would measurably lessen the cost of an effective barrier in terms of material, manpower, and time, we must plan for conventional barriers because of the uncertainties associated with the present ADM's. However, we believe that many of these uncertainties, both military and political, could be overcome by the development of advanced munitions possessing the features previously indicated.

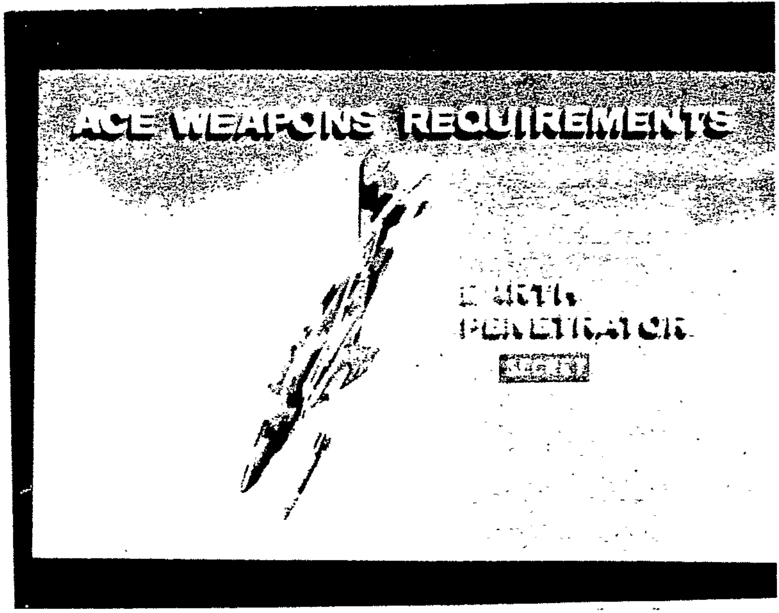
This covers the ground systems needed in direct support of the field army. Lance, the replacement for Honest John and Sergeant, is in development, and if fielded in sufficient quantity should provide a major improvement in our capabilities.

In a tactical nuclear war in Europe, SACEUR and his major subordinate commanders will depend heavily upon tactical air for extended attack and interdiction—both to counter the longer-range nuclear threat facing them and to isolate the battlefield through rear-area disruption and interdiction. Armed or strike reconnaissance will be required to locate and destroy mobile or imprecisely located nuclear targets, and to strike at direct supporting targets beyond the range or capability of the ground commanders' organic delivery systems.

We presently have a fairly wide range of air-delivered weapons and yields available to accomplish the preplanned interdiction and scheduled strike programs, but we lack highly-accurate, all-weather, air-delivered weapons, an essential requirement for today and the future for closer support, for specific interdiction targets, and for armed strike reconnaissance. Because of delivery CEP's associated with today's systems, it is necessary to program multiple or repetitive strikes and higher yields in order to assure the desired degree of damage. We need to develop highly accurate, all-weather systems which will permit the successful nuclear attack of targets utilizing fewer weapons and lower yields. Limitation of damage or damage control must be an important aspect of nuclear planning, since much of the area of tactical employment is NATO territory. To accomplish these ends, several types of weapons are required.

We need an earth penetrator (see Figure 10) designed for both internal and external carriage for delivery at subsonic or supersonic speeds. Such a system should achieve a combat CEP of 100 feet or less, have a dial-a-yield capability, and be capable of penetration to optimum depth for cratering based on yield. Such a weapon would be very effective against land or underground point targets requiring severe earth shock or cratering, such as bridges, missile silos, and runways. It would also be very effective employed against targets near populous areas where collateral effects must be minimized.

We are also interested in penetrator offshoots, such as Bayonet (see Figure 11), which offer highly accurate CEP's. With such a system we could attack point targets currently suitable only for ADM's. In fact, an all-weather Bayonet could be employed to assist in denial operations, should an ADM barrier for some reason not be completed.

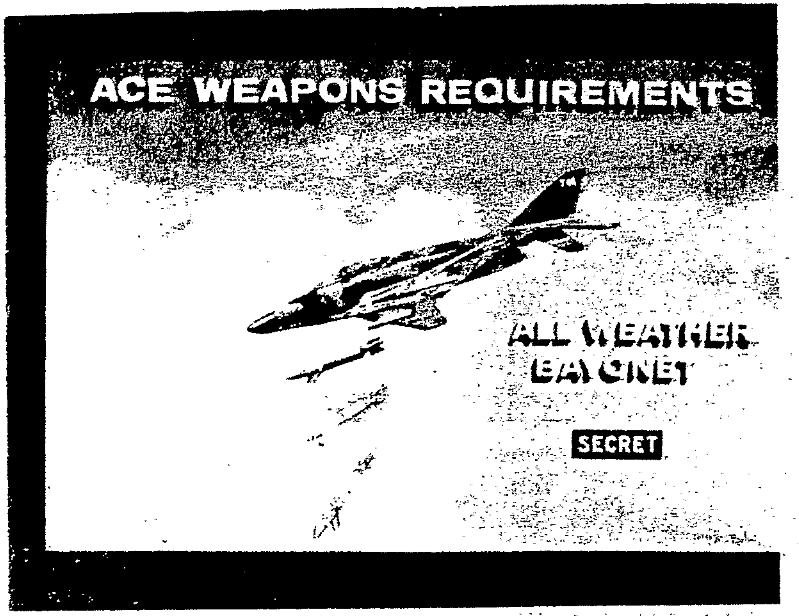


ACE WEAPONS REQUIREMENTS

EARTH PENETRATOR

SECRET

Figure 10



ACE WEAPONS REQUIREMENTS

ALL WEATHER BAYONET

SECRET

Figure 11

In order to reduce attrition rates of tactical aircraft employed against heavily defended targets, there is a real need for all-weather stand-off weapons (see Figure 12) sufficiently reliable to permit the probability of launch with an escape capability. Such a system should have a range of greater than 40 nm after release, should provide a dial-a-yield capability, and achieve a combat CEP of 100 feet or less. Even a modest reduction in attrition rates would provide large dividends in the form of additional sorties. Further, it would reduce critical time over target conflicts in the nuclear strike plan and reduce pilot and aircraft exposure to nuclear fallout.

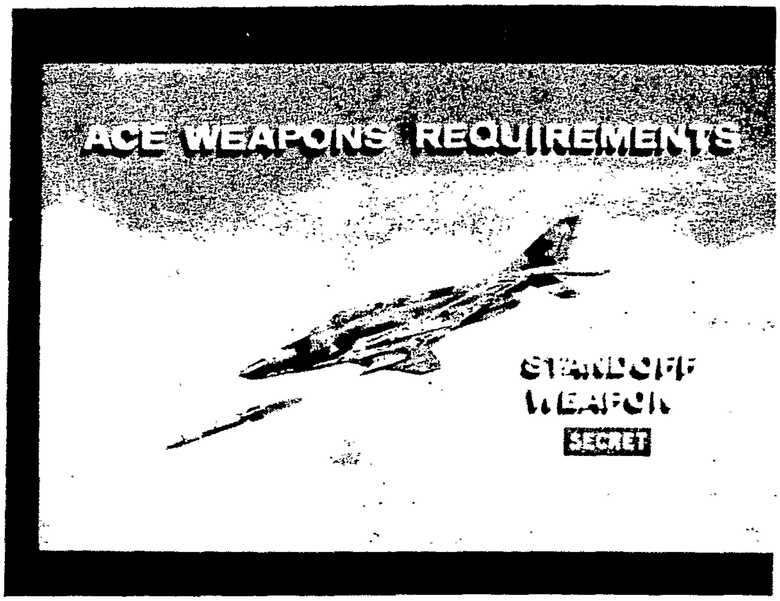


Figure 12

On the naval side, we need an advanced surface missile system (see Figure 13) to update the capabilities of the fleet and replace the Terrier/Talos. This improved surface-to-air/surface missile system should have selectable yields up to 10 kt. It would be launched by surface units (destroyer or larger) against naval surface combatants, aircraft, and missiles.

There is one final long-standing ACE requirement that I wish to mention: A requirement for a European-based NATO missile system to counter the consequential and modernizing Soviet IR/MRBM threat to the theater.

These factors have caused the emergence of a probable adverse asymmetry in our overall NATO strategic nuclear posture vis-a-vis the Pact which poses a grave threat to NATO Europe; i.e., a growing capability for the Soviets to exploit their strategic nuclear parity—or even superiority—by "decoupling" their IR/MRBM forces from their intercontinental nuclear forces for use as a separate and viable nuclear threat to ACE. We in NATO Europe have no comparable weapon system physically located in Europe with which to counter this threat. Only our external

Polaris and Minuteman missiles, and a very few obsolete V-bombers and SAC's B-52's, can attack these Soviet IR/MRBM's, and their coverage of this threat to Western Europe is spotty, incomplete, and (in some instances) untimely.

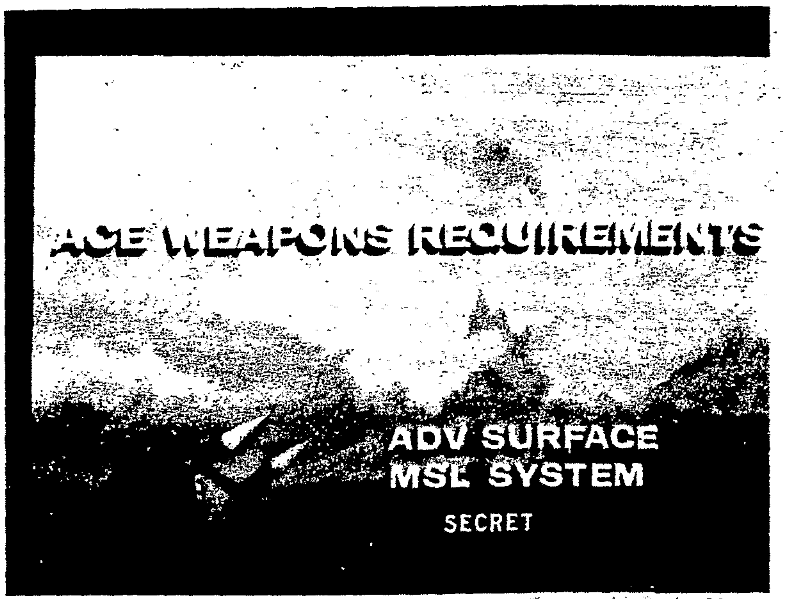


Figure 13

The Soviets obviously recognize the inability of our European-based nuclear systems to attack their IR/MRBM's. If the Soviets come to believe that they have effectively matched the US at the ICBM/SLBM level, they may think that they can use their IR/MRBM capability to threaten or strike Western Europe, without a genuine risk of response by US external forces. In the face of such a threat, and with no comparable or credible deterrent capability on our side, Western Europeans are clearly exposed to and might succumb to IR/MRBM blackmail. We continue to think it wise to develop and position in ACE a comparable or improved weapon system, capable of countering this Soviet MR/IRBM threat to Western Europe. This system should be, nominally, under the operational command of SACEUR, though, of course, subject to the President's release authority. We think this is needed to improve the credibility of our European commitment. This system must convince the Soviet planners and, equally important, our European Allies, that Russia will not be a sanctuary in a nuclear attack on Western Europe—even if external US forces are, for any reason, not invoked in a counterattack.

We see the characteristics of this system generally as follows: it would be carried by a highly mobile system, fully transportable, with missile ranges up to 2000 miles. The weapons yield would range from 10 to 200 kt using multiple warheads. It would be launched from a transporter/erector vehicle containing its own command post directly responsive to directives from the major commander, and with an integrated arming system, directly responsive to remote enabling authority.

In summary, gentlemen, I have outlined the threat as I see it, our capability to respond to this threat, and our weapons requirements to increase the flexibility of our response. Our nuclear commitment to NATO is clear and unequivocal and has not changed since first enunciated in December 1957. As you may recall, at that time a communique of NATO heads of state established stocks of nuclear weapons in Europe which would be readily available for the defense of the Alliance in case of need.

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While our commitment to NATO has not changed, weapons technology has changed—the Soviet nuclear posture has changed dramatically—and we must make better use of our US technical capabilities to provide us with increased flexibility, greater options, improved weapons capability, and better response potential. This is not the "whole" of our job, of course, for we need better concepts, strategies, and control systems—but the starting point I want to emphasize to this audience is the need for better, newer weapons.

I am convinced that tactical nuclear options are meaningful only so long as the United States is superior at each succeeding stage of possible escalation, that is, no matter how the escalation goes, the US and NATO come out better than the Soviets and the Pact. Our capabilities relative to the Pact's have declined so steadily that any superiority beyond the battlefield is extremely doubtful.

I firmly believe that the ACE nuclear program has played—and will continue to play—a major, if not the dominant, role in the maintenance of relative peace in Europe. Although it has involved a major expenditure of US resources for the past 20 years, it has been a significant, highly visible part of a credible US nuclear deterrent. Also, in my view, at least, this tactical nuclear program in US ACE remains the single most unifying element in NATO. But our ability to underwrite the security of NATO Europe (or our own security, for that matter) with our external nuclear forces and our aging tactical delivery capabilities is rapidly diminishing (if not already inadequate) through obsolescence and lack of required capability.

If we are to ensure that the Alliance remains viable, and the US nuclear deterrent remains credible, we must reverse our apathy toward nuclear improvements; we must launch a determined program in weapons developments and weapons improvement to meet our present and future requirements. We cannot rest on the laurels of 20 years of relative calm in NATO Europe; and we cannot continue to face today's or tomorrow's tasks and threats with yesterday's capabilities.

Question and Answer Period

McDONALD (LRL): I was curious about your mobile missile system for Europe. Of course that has come up, off and on, over the last 10 or 15 years, and usually it gets short-circuited. How do you feel the Europeans would respond to the installation of such a system?

BURCHINAL: There are a couple of comments we might make. One, the French are putting in a ballistic missile system, not mobile, but in hard silos. Second, we should bring the Europeans face to face with the hard relationship that exists today between strategic forces, recalling Mr. MacNamara's statement in San Francisco two years ago, that strategic nuclear forces can be depended upon to deter only their own employment and they don't go much beyond that—and that their employment is, in fact, an incredible action and you can't build a credible strategy on an incredible action. You point out, too, the real possibility of a decoupling of the IR/MRBM, which we always said we would underwrite with external forces, and it doesn't take a mathematician to tell you that we aren't doing that today. I think you would receive a reasonable degree of acceptance. In the past when we were told it was politically not acceptable to NATO Europe, we were told this in the context of our own people going to them and saying, "You wouldn't want a horrible weapon system like that deployed on your land, would you?" And they'd say, "No, no, of course we wouldn't." I think with a positive approach this could be an acceptable system. Particularly attractive, I think, would be that part of the proposal which puts it under SACEUR's operational command as a European system, and takes the Soviet out of the sanctuary category as far as the European war is concerned. I think that is essential.

McDONALD: I was curious to know if the implementation of that plan might almost demand that the European nations desire or require an antiballistic missile system, since they are now more attractive targets than before.

BURCHINAL: Not necessarily. The worrisome things in the equations are their asymmetries. If you have an asymmetry in, let's say, our external forces SAC and Polaris and the Soviets' ICBM's and subs, and you have a total asymmetry at the IR/MRBM level, and you have a substantial superiority in favor of the Soviets at the tactical ballistic missile level and at the longer range rocket level, and then a total superiority of US-NATO in the battlefield tube delivered type weapons, it's these asymmetries that create instabilities and make the course of a possible conflict difficult to determine and reduces the decision makers to indecisiveness. What I am looking for is a missile system that will counter and stand-down the Soviet option to decouple and use his IR/MRBM. I want to work under that level of violence in terms of military forces that NATO Europe builds to maintain its deterrent and stability against the Pact forces; and we can do it below that level.

COTTER (SLA): Could you tell me what the attitude of the West Germans might be to the ADM and in particular to preemplaced ADM's?

BURCHINAL: Yes, I think we may be able to get a better answer to that in another presentation. The Germans are not enthusiastic about the present ADM; it is so constrained and limited that I don't blame them. I think they would be much more likely to accept an effective ADM barrier plan, let's say, with the kind of ADM that I talked about and most of which I think is moving into the design phase now. It doesn't necessarily require preemplacement; it might require some preparation of emplacement sites or holes, but not even that necessarily, because we can dig holes pretty fast these days. The new ADM could be reserved for forward employment or deployment during a period of some tension or some warning. At the present time, as you may know, we can't even move the ADM's out of the rear areas without specific guidance and approval from back home. So they are almost in an unusable category at the present time. I know at the German military level we would get substantial acceptance of this ADM level employment and concept. It would have to follow through on the FRG side that they also develop evacuation plans to move the civilian population out of the barrier zones, though they may be heading for the rear pretty fast anyhow.

LOWRY (RAC): Is it a military or a political consideration that requires a mobile rather than a hard, fixed ballistic missile, or a mix of both, to attack the Soviet missiles?

BURCHINAL: Both.

ETHRIDGE (Aberdeen): You have described the large imbalance of forces. Because of the time required to develop weapon systems this imbalance may become even worse. Do you feel that this situation provides a very strong temptation for the Soviets to consider invasion now or within the next few years?

BURCHINAL: No, not now nor for the next one or two years. I think that before we see the Soviets venturing into the center, they will be more active on the flanks. I think they are pretty afraid of the center today; the balance there is a very delicate one. Depending on how that adventurism goes, we may well see an increased appetite to begin to probe a bit in the central part of Europe. I might add that I am not very encouraged about our ability to do much about that at the moment, either. Their capability for operations far from their own homeland is growing; their presence in the Mediterranean today is really impressive. I see that as a forerunner to their branching out, creating peripheral issues, not directly confronting NATO, not directly confronting the US, but working through a proxy. Then, depending on how that goes, they perhaps will develop a greater appetite. So I think we have time.

GIRARD (RAC): From the two graphs you showed us of ICBM and SLBM trends, I draw the conclusion that in effect the Soviets did not accept the offer of parity. If this is true, then I, at least, understand a little better the current craze for some kind of arms limitation agreement negotiated essentially this calendar year, or we will be faced with very unpleasant alternatives for programming. Do you agree with this, sir?

BURCHINAL: Totally.

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Maj. General Richard A. Yudkin
USAF, DCS/P&O

THE CHANGING CONTEXT

The theme for my "sermon" here today is that there is always a changing context with which we must contend, and for each generation of contenders, the past looks attractively simple, the present unpleasantly difficult, and the future dangerous or impossible, or even impossibly dangerous. Despite any inborn hostility, man's evolution reflects adapting to contextual change. National evolution is necessarily similarly conditioned.

My purpose today is to identify a context within which the use of tactical nuclear weapons—or the kinds of operations usually associated with such weapons—might become more obviously relevant to the environment within which we find ourselves, and therefore more demonstrably rational to decision makers at national level.

To do this, I must—as I view the problem—start by saying that the power relationships around which we constructed our concepts of strategic and tactical nuclear operations are drastically changed from what they used to be. Thus, the established understandings of these operations demand, as a minimum, review and more likely—if we decide the terms continue to be useful—significant adjustment.

While I do not mean to call into question the framework which structures our symposium, I am suggesting that we need to examine very carefully what we mean by "tactical" nuclear weapons and the continuing relevance of what we have understood when we used this description. We might recall that "strategic" bombers and "tactical" fighters have effectively performed seemingly reversed roles in South East Asia. Perhaps it is not or should not be restraints on hardware, target, or geography which are given importance as criteria; perhaps constraint on objective is more properly the determinant. The very nature of nuclear weapons necessarily gives their employment a strategic significance; this employment may concurrently have tactical value.

Hence, while I will talk most about nuclear weapons that fit within the category we have called "tactical," I suggest that in talking about them I must necessarily give primary attention to a role and impact that are essentially strategic. Such latitude of discussion seems essential, since such weapons may find important applicability beyond the battlefield itself—in what I would term "selective nuclear operations." By selective nuclear operations, I am referring, at this stage very generally, to operations of strategic value conducted at levels below all-out effort. In this sense, selective can refer to targeting, mode of delivery, purpose, or desired effects—in short, taking full advantage of every option technology affords us. The important distinction here is that such operations are specifically conceived of, developed, and carried out so as to achieve strategic, but limited, objectives. The concept grows from an attempt to recognize that simple solutions like total defeat and unconditional surrender may not be rational goals if the opponent has a true assured destruction capability. That recognition makes it a matter of utmost concern to find ways of fighting which exhibit a better trade-off between the degree of influence upon the enemy and the degree of risk involved in exerting that influence.

I must emphasize that the concept of selective nuclear operations is not intended as a replacement for other nuclear options, but rather as a complement to them. Considering our nuclear capabilities in terms of strategy options—or broad mission and employment categories—it has been the practice in recent years to identify three main options. These are Assured Destruction, Damage Limitation and Theater Operations. I regard "selective nuclear operations" as a fourth major strategic option which sits well alongside these other three employment groupings. It will be apparent from my subsequent remarks that I do not regard these groupings as mutually exclusive. Rather they are overlapping and ought to be mutually supportive; certainly the last two of the four options must include an important portion of what we have called tactical. With these basic characteristics of selective nuclear operations in mind, we can examine the case for the relevance of this strategy option to the realities of the present international environment.

In order to delineate the need for a distinct alternative which has developed in response to the political and military realities of the postwar world, I would like to trace the development of our strategic policy through the postwar years.

A major factor in the determination of postwar strategic postures was the growing desire to limit the Communist threat geographically. Known popularly as the "policy of containment," this concept fit nobly into the traditional American mold for defensive, nonaggressive strategy. Armed with a nuclear monopoly that was to be surprisingly short-lived, American planners revolutionized strategy by finding an effective defensive role for a weapon which seemingly was made expressly for the offensive strategist. If you will permit such a simplification, nuclear deterrence was thus born of status quo goals and moral preferences.

The "ultimate weapon" has served well in this essentially defensive role; yet, it has paradoxically produced needs for complementary strategies of a quite different nature. The conflict in Korea was but one indication that the extreme character of massive retaliation might prove incompatible with the often-undefined "line" of containment. Although the line remains relatively well defined in Europe, its nature and location have proven less obvious in the Middle East, Southern Asia, and the Caribbean. The threat of Communist aspirations has taken on the more subtle expressions of ideological and political expansion. The contemporary deterioration of the monolithic nature once a characteristic of the "Communist Bloc" is bound to produce future changes in our own policies. Political independence and economic development have joined forces to produce nationalistic complexities within a political world once simply and accurately described as "bipolar." Strategic advantages once enjoyed by the US have been modified, if not overcome, by Soviet advances, while years of effort dedicated to achieving some system of nuclear arms control continue to be frustrated by understandable preoccupations based on national security interests. These realities are complicating and will continue to complicate the effort to construct meaningful military policies and capabilities while they make it more urgent but more difficult to find ways to bring the great dangers of the nuclear era under some form of workable control.

The 1960's saw one obvious effort aimed at overcoming the strategic shortcomings of overdependence on massive retaliation. The doctrine of "flexible response" has attempted to provide a nonnuclear answer to major aggression. In practice, however, it has yielded some other, perhaps unforeseen, results. "Flexible response" has come to mean almost exclusively "conventional response." Merely by having the obvious intent and capabilities to meet all less-than-ultimate threats in a conventional manner, we have isolated our nuclear capability at the top of the conflict spectrum, and it has lost much of its applicability to anything less than total effort. Simply categorizing some of it as "tactical" does not seem meaningful. In other words, flexibility has been equated or limited to conventional action to an extent that ultimately inhibits flexibility.

This seemingly counterproductive outcome has been accompanied—even accelerated—by developments in the military force relationships between the US and the Soviet Union; here the most salient fact is the changed strategic nuclear balance. Both the US and the USSR now possess secure second strike or Assured Destruction capabilities. The Soviet leaders are fully aware of this condition which they have sought so hard to achieve. They are likely to have drawn a fundamental inference from the changed strategic relationship: that the United States might thus be deterred from escalating to high intensity nuclear war in response to a Soviet nonnuclear attack or limited nuclear attack.

We ought also to ask how the Soviets might view the impact of the changed strategic balance on our allies, especially in the critical European theater. The member nations of NATO—ourselves included—have been unwilling to maintain sufficient nonnuclear forces to insure the defeat of an all-out conventional attack by the Warsaw Pact. Hence the threat of deliberate nuclear escalation plays a key role in NATO strategy. We have been at some pains over the years to make sure that the Russians were aware that, should a conventional defense prove inadequate, NATO could reasonably choose to turn to nuclear weapons.

But what made a NATO nuclear response reasonable was that it was backed by the strategic nuclear forces of the United States. In the face of that US deterrent, the Soviet Union was unlikely to respond to a NATO nuclear initiative in a way that would result in the nuclear devastation of Western Europe. A large scale Soviet nuclear attack on Europe, according to US declaratory policy, could bring full US nuclear retaliation directly against the Soviet homeland. But in today's context, a full retaliatory assault would pose a high risk of the consequent destruction of the

United States. In other words, in a decision that never really could be made in advance, in a decision seriously conditioned by the moment, the US may think twice about making a full SIOP response to even a serious Soviet move in Europe. The Europeans sense this; so do the Russians. This leaves the NATO nuclear option, as it is structured today, with a less certain foundation and hence with inevitably reduced credibility in Soviet eyes.

The Soviet assessment of the situation, in sum, could be that not only is there reduced probability of massive US retaliation to less-than-all-out aggression, but that there is also a lessened likelihood of a deliberate nuclear escalation on the part of NATO. The Soviet conclusion then might be that, while there remain obvious and extremely great risks to any military aggression against NATO or other areas, those risks are substantially less than they have been in the past.

I want to be very clear that I am not suggesting that the changed strategic relationship and the presumably changed Soviet assessment of risks mean that Soviet leaders are now more likely to initiate aggression or have a greater incentive to do so. We are all aware that there are a number of influences which affect Soviet behavior, and taken all together it would appear that the USSR has little to gain and a great deal to lose from rocking the boat to this extreme. However, deterrence is a structure that should be designed to hold up not only on a fair summer day but in rough weather as well. No one can forecast with certainty what the future may hold in the way of incentives for Soviet action or in the way of Russian perceptions of threats against which the USSR might wish to intervene. We have recently been reminded of that basic uncertainty by the events of 1968 in Czechoslovakia, the Brezhnev doctrine, the assertion of a right to intervene in West Germany.

If we shift our attention to other areas—to the Far East, for example—we can find that there too the changed strategic balance implies important shifts in the deterrence equation. It seems clear that over the next few years some modification of our forward defense strategy in the Asian Pacific area is inevitable. With the likely adjustment of forward deployed US combat elements and some shifting of defense responsibility in forward areas to national or regional security forces, the deterrent and backup role of US forces will take on new significance. Although our strategic forces can continue to deter direct attacks on the US, in Asia as in Europe the nature of this deterrent becomes uncertain as Soviet and Chinese Communist nuclear forces improve and increase. It is probably apparent to the USSR, to Communist China, to Japan, Australia, other allies, and to neutral states, as well, that we would enter into an all-out nuclear war only as a last resort when the most vital American interests were threatened. Therefore, against the backdrop of our more massive strategic response options, forces designed for application to theater problems of deterrence or war fighting must have a range of nonnuclear and nuclear capabilities to include a capacity for selective nuclear operations.

Moreover, in the future, US national authority may wish to have the option to decouple theater threats from intercontinental threats—and this may apply, of course, to Europe as well as other theaters. This would seem to require forces capable of significant nuclear response but whose use clearly signals the intent to hold objectives limited. Given the growing independence of regions such as Western Europe and of a state like Japan, it is conceivable that our allies themselves may desire some form of decoupling, although their reasons and ours may be anything but identical.

These evolving problems, both political and military, illustrate to some extent the pressures for change, the need to rethink our strategic alternatives. For while Assured Destruction remains the cornerstone of national military strategy, it is not, nor can it be, the entire structure. Because our nuclear retaliatory capability in the past has deterred a far broader range of opponent actions than we can now be sure it will, there is a tendency to persist in attributing to Assured Destruction a far wider deterrent role than it can in fact perform. If we accept that mutual Assured Destruction abilities tend to counterbalance one another in the overall deterrence equation, we must then recognize other possibilities, options, and forces which must be dealt with. In an environment approaching mutual deterrence at the ultimate level there may be more risk-taking and greater instability at a number of lower levels. But it is precisely the military component of deterrence to these less-than-all-out threats, and the means to deal with them, which has not been adequately developed. To retain control in such an environment requires concepts—and forces—that go beyond earlier views of deterrence. It will require a superiority in exploitable, politically relevant, usable military power. It will require military force that can be credibly threatened because it can be credibly committed to action. In a sense it requires capabilities such that the National Authority can judge that the risks of the nuclear action would be less than those of the various military and nonmilitary alternatives.

My remarks thus far have been focused upon an examination of the needs to which our nuclear strategy must respond and upon the role within that larger framework of a proposed new nuclear option. I should now go one step further and ask the questions: "How must such an option be constructed, and in what ways should the strategy be adjusted if we are to satisfy those needs?" Let me outline the criteria which I think must be met. To begin with we must recognize that "selective nuclear operations" refer to methods of nuclear employment designed to influence the enemy to terminate the conflict on favorable terms before the conflict reaches the most destructive levels. Such operations should offer some prospect that they will decrease rather than increase the risk that the conflict will expand to high intensity nuclear war. They must offer the National Authority opportunity for tight control over the conflict and especially limit the possibilities for uncontrolled escalation.

A second requirement of the nuclear options which we devise is that they be able to achieve their intended effect against an opponent who will retain significant residual military power. In one sense it is just this condition which makes selective nuclear operations a feasible option—the fact that the opponent possesses relatively invulnerable second-strike forces eliminates the case for preemption by him.

For such options to appear reasonable to the National Command Authority, they must promise more than a competition in resolve by way of a war of nuclear attrition or than a simple matching of attacks without strategic purpose.

The effectiveness of selective nuclear operations as an element of US deterrence depends ultimately on Soviet belief in our capability to maintain a relative advantage in an escalatory war of attrition. Should any exchange of limited nuclear attacks occur, the effectiveness of US forces in achieving their missions and the failure of Soviet forces to do so would be the most convincing deterrent to any further such attacks by the USSR. Foreknowledge on the part of Soviet leaders of the qualitative superiority of US forces in selective nuclear operations would be likely to deter the USSR from initiating a limited attack competition.

Finally, these operations must imply or embody a reasonable and believable strategy or "theory of victory" which explains what the opponent can be expected to do and why, and also provides verifiable checkpoints for confirming whether the strategy is working as expected.

These criteria suggest that an essential characteristic of selective nuclear options is that they couple persuasive military actions to political objectives. They would be paced as much by diplomatic and political events as by military considerations—their effectiveness being related to roles of allies, international and domestic opinion, and national objectives. These operations would require the coordination of military plans and action with political and diplomatic effort to achieve a set of objectives far broader than strictly military ones: These coordinated activities seek to reduce the opponent's perceived national interest in the crisis versus the risks and possible losses; at the same time they increase his awareness of the depth of US interest and commitment to employ effective force; they seek to gain domestic and international support for US action and develop such pressures against the opponent; they seek to insure for the United States and deny to the opponent critical military support from other nations; they emphasize to the opponent that he is vulnerable to our operations and that continuing hostilities will be increasingly to his disadvantage; and they communicate to the opponent what we desire him to do while signalling both the intent to limit actions and the readiness to terminate on reasonable terms.

To achieve these objectives implies, on the military side, the discriminate and controlled application of force to communicate demands and intentions clearly and to achieve precisely specified effects—effects reflecting and supporting the objectives of the National Authority. This means the development of a range of forces and weapons usable for controlled, selective, and discriminating nuclear attacks to demonstrate both resolve and the ability to coerce without pressuring the adversary to launch massive attacks. Compared especially with forces for the Assured Destruction mission, the functional orientation of forces for selective nuclear operations would require significant design differences. Mobility, penetration effectiveness, delivery precision, yield, and limitation on collateral damage are examples of areas in which sharp differences would be discerned.

These considerations suggest that the success of such operations in terms of achievement of their essentially political objectives would be in large part dependent on the availability of what we might call focused-effect nuclear weapons. They require delivery systems providing extreme precision and reliability in target identification as well as delivery accuracy. Closely associated is the need for near-certain target kill probabilities with minimal required sorties.

Some of the aspects of developing a selective nuclear option have been examined in a study effort bearing the name NU-OPTS and conducted within Air Force headquarters with extensive assistance from our major field commands and the RAND Corporation. The first part of the study, completed early in 1968, was concerned with the impact of limited nuclear operations on the residual capacity for performing the Assured Destruction mission. In the second phase of the study just recently completed, the objective was to determine whether it was indeed feasible within certain rather stringent limits on collateral damage and political and military sensitivity of targets attacked to achieve precisely specified objectives with limited numbers of attackers. The study systematically examined an arbitrary selection of representative targets, attacked with a range of up to 75 weapons with the focus on technical or purely military feasibility of target destruction. The finding was that such operations are feasible; in other words, that we could attack point "X" in the Soviet Union, for instance, without causing collateral damage or involving US losses beyond the bounds set for the problem. Another part of the most recent NU-OPTS study examined the political problems and requirements, and I will comment on those a bit later. So far we have only made a start on the problem but we have established to our satisfaction two crucial points which make it possible to go on—that with forces now on hand or planned for the next three years, selective nuclear operations would be operationally feasible and that within levels foreseen they could be conducted without jeopardizing the US Assured Destruction capability. We need a greater effort to determine what the most suitable sets of targets would be for such operations and if necessary to design weapons tailored to such targets.

We may also conclude that the delivery systems and the nature of the operations and the weapons would have to be uniquely and rather obviously discriminable by the enemy from those used for Assured Destruction or all-out counterforce attacks.

Guidance systems, command and control, highly accurate and reliable intelligence, flexible and timely planning and decision-making, and penetration against undamaged defenses are some of the other areas which obviously present great problems.

Finally, I want to underscore this point: The selective nuclear operations I have discussed would not be intended as a substitute for existing battlefield nuclear capability. Instead, selective nuclear operations provide a necessary back-up to lower level escalatory options, and to their effectiveness as deterrents. They could provide a possible alternative to battlefield engagement.

My remarks so far today have been directed toward considerations which might make some types of nuclear employment relevant in the military context of a particular crisis. But we all recognize that the ultimate test of the relevancy of a nuclear option lies in its acceptability to the President. Such acceptability in turn depends upon more than the criterion of military relevance. The President must be sensitive and responsive as well to political, moral, economic, and other considerations and pressures which may be associated with any nuclear employment decision. It seems clear that among such pressures the impact of attitudes and opinion—and questions of domestic and foreign support—will have an important influence on Presidential decision-making.

It seems equally evident that the relationship between opinion and political decision-making is extremely complex, and its precise nature is unpredictable and is likely to vary according to the nature of the crisis situation. But if military men have a responsibility to present the President relevant and therefore reasonable alternatives, it seems necessary to have some feeling for the nature of the problem he confronts.

Consider, for example, both the complexity and importance of problems involving the attitudes of allies toward our use of nuclear weapons in different contingencies. Let me raise just a few questions that point to some of the most obvious issues in this regard. In the context of combined defense, as in NATO for example, is consensual agreement among allies regarding the necessity of nuclear employment an absolute requirement for our considering such employment? What would be the political effects of employment without consensual, or even unanimous, agreement? Would such effects be more harmful than the threat we are seeking to neutralize? What are the effects upon allies of unilateral employment? Do we care about such effects, and in this context, do we really care about allies? These are the kind of provocative issues which must be faced up to in considering nuclear alternatives.

The President, as an elected officer, is likely to be especially attuned to US domestic opinion. Particularly if success in a prospective conflict will call for great sacrifice or long endurance by the nation, the President is likely to give very careful attention to public attitudes, to avoid actions which conflict strongly with public expectations, and to attempt in all his moves—including military ones—to build public support.

How might we view the impact of US public opinion in a situation involving nuclear issues? The impact of opinion is likely to be greatest in a slowly building crisis, and probably of least immediate influence when a conflict arises abruptly and is swiftly terminated.

In this respect we must recognize the crucial role of adequate defenses in any limited nuclear war, or in any nuclear crisis. The presence or absence of such defenses could well be the key variable both in mobilizing public support and in sustaining the resolve of the decision-maker.

What attitudes characterize US public opinion toward nuclear issues? The first thing to be noted is that public opinion perceives—in fact public opinion has been conditioned to perceive—a nuclear act as a qualitative change in the level of hostilities, a change involving the highest degree of international political significance. A closely related attitude is that any nuclear use is somehow automatically linked to an all-out thermonuclear holocaust. The second attitude is, in great part, the result of a national security policy of near-exclusive emphasis on Assured Destruction. This declared strategy has suggested to many a high probability that any nuclear use would produce consequences compared with which almost any condition would be preferable. Let me say that I find it difficult to make a serious or convincing argument against that view, within the contextual limits of that strategy. As I mentioned earlier today, what I feel is required as an alternative is a strategy—and supporting capabilities—which offers something more positive and which at least offers a plausible possibility of excluding holocaust, or anything close to it, as a risk attendant on effective action. Such improvements are essential if the credibility and hence the effectiveness of deterrence is to be sustained.

To recapitulate briefly then, US nuclear strategy since WW II has attempted to structure a defensive and retaliatory-deterrent posture which conforms very closely to the public conception of the immediate leap from first use to holocaust. And I think it is clear that this strategy has proven successful up to now. In Europe, for example, it was presumably the awareness that local aggression carried with it the risk of initiating a chain of reactions leading eventually to wholly unacceptable damage that at least in part deterred the Soviet Union from launching such aggression. I believe it is still obviously to the advantage of the United States to preserve the notion that there is no assured discontinuity between least and greatest nuclear employment.

However, in an environment of mutual Assured Destruction, the risk or threat of holocaust is no longer enough, by itself, for deterrence. Other more relevant and more credible threats are required for deterrence, and they must be supported by usable and relevant capabilities. Consequently, while the Assured Destruction option must be maintained at all costs, it cannot be viewed as a panacea, deterring (and usable in) all lesser intensity situations. Should circumstances propel the US and USSR into a low intensity nuclear war, or should US national interests be threatened to the extent that nuclear force is required to renormalize the situation, National Command Authorities may prefer to exercise restraint in the use of weapons, limit target categories of attack, and discourage further escalation to higher value targets. Such controlled and deliberate operations can provide an additional option short of fullscale nuclear attack and can make more politically credible our international commitments which are not directly related to our national survival.

A question which relates in part to the subject of opinion has to do with the stability of deterrence once any nuclear weapons use had occurred. It has been suggested that pressures for or against the use of the Assured Destruction forces will intensify greatly once a nuclear conflict has begun. It is implied that, however stable the structural relationships between the opposing strategic forces, this stability may somehow be overwhelmed by emotional reactions of leaders or by the demands of public opinion. I think this is unlikely to be the case although obviously no one can offer answers on this matter with any feeling of certainty. The pressures against the launching of the Assured Destruction force will not change following the use of a nuclear weapon because that opposition pressure is already at its ceiling, already fully generated. On the other hand, I would agree that pressures in favor of executing the Assured Destruction capability would become more vocal and more strongly heard after the outbreak of a nuclear conflict. Those pressures for use, however, will not reach the same magnitude as the pressures against—which include not only emotions but hard calculations of self-interest. And I believe this resistance to the launching of Assured Destruction will hold up on both sides, in the USSR as well as the US.

Thus at the highest levels we can anticipate that a relative stability of deterrence can be maintained, a stability which can be of an enduring nature. It is a stability which does two things: It makes a concept for selective nuclear operations feasible; and at the same time it requires such an option if we are to deal effectively with likely threats.

Within Air Force headquarters the NU-OPTS study effort has examined some aspects of the problem. While its conclusions are both partial and tentative, one conclusion strikes home with great force: Limited nuclear war is a possibility inherent in the logic of the nuclear environment. Our strategic posture at present appears to be deficient with regard to options appropriate to such warfare. At the same time there appears to be no convincing analytical argument which demonstrates, on political-strategic grounds, that not having such options, sustained by requisite preplanning, is better than having them.

I would like to conclude my comments with a brief summary, in an attempt to refocus and correlate some of the points which we have covered.

At the outset I noted that our current strategic nuclear posture has been the result of an evolutionary process in which perceived threats, public opinion, and defense policy in general have all played central parts. The political and power realities of the earlier postwar years gave such posture real meaning, applicability, and effectiveness, as evidenced by over twenty years of successful deterrence. However, recent changes in the world situation, in the superpower strategic balance, and in our own priorities have combined to weaken the military component of our deterrent posture. The tremendous power we can generate is compromised by its reduced credibility at lower-than-ultimate levels of conflict. The opportunities that such inflexibility might offer Soviet planners are alarming.

It seems clear that if the changing international context has narrowed the relevance of Assured Destruction to the point at which other kinds of warfighting take on increased significance, then it becomes our duty to develop the operations and hardware to cope with such changes. My comments today have been directed towards showing that precisely such a challenge exists today. The wide range of conflict possibilities that presently exists between the levels of battlefield nuclear exchange and full SIOP warfare suggests two things to me: first, a requirement for strategy options designed to deal with such possibilities; and second, a requirement for the forces and types of weapons to make such options a reality. This second point seems worth reemphasis in light of the orientation of this symposium: Work in the development of tactical nuclear weapons is likely to bear the greatest future significance through its contribution to the range of alternatives within the conflict limits I have just described—that is, in terms of its contribution to a strategy option of selective nuclear operations.

I would like to close by seeking the support of a somewhat familiar authority, the British strategist, Liddell-Hart. Analyzing the fall of France in 1940, he concluded that, "... the defeat of France started from a failure of military doctrine to keep pace with changing conditions. It was due, above all, to obsolete habits of thought and the perpetuation of the slow-motion methods of WW I." The message strikes home for me with great impact. In our era of unprecedented risk, the modern equivalent of the much precedented error of being "one war behind" becomes an unacceptable alternative.

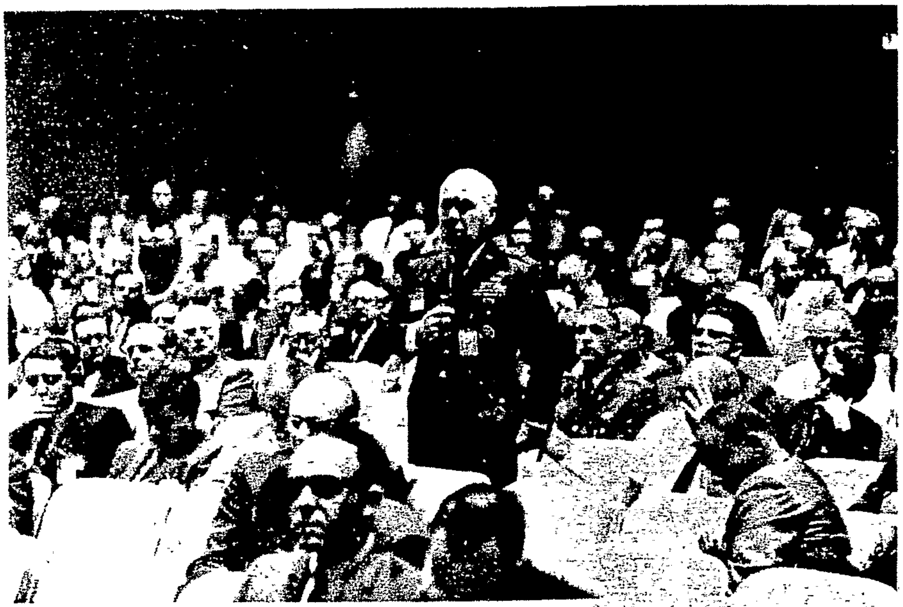
Question and Answer Period

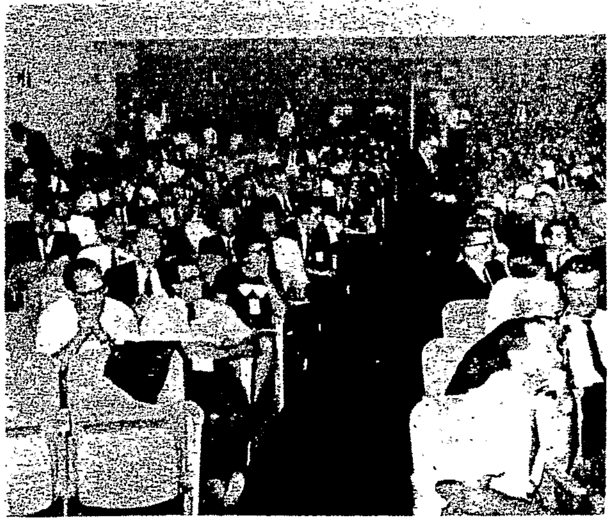
WALSKE (DOD): I am under the impression that the President does have some options of the type that you were describing. I wouldn't say they are up to what they might be, but if it were appropriate to put 75 weapons in some theater that could be reached by an aircraft carrier, that option would be there, for example. The Air Force can do other things. I wondered what specifically in the way of hardware or delivery systems you had in mind that need to be added in order to have the capability or the option that you envision?

YUDKIN: In the two phases of the NU-OPTS study, we concluded that the capability did exist today to accomplish certain ranges of activity with weapons now available. But it also became apparent to us that there were areas of qualitative improvements, and I stress qualitative improvement in particular. I am not prepared today, beyond the general descriptions that I offered, to specify the new recommendations we are going to submit for forces or weapons. Those are still under study. As a matter of fact, we briefed the Secretary of the Air Force on part of this study as recently as last week. We are not yet in a position to forward recommendations with specific proposals for change in force posture, specific proposals for design, and change in characteristics of weapons. I might add that part of our proposal in the briefing of the Secretary the other day, was to launch NU-OPTS 3, which is a further development of NU-OPTS 1 and 2; this represents an effort to achieve even greater definition in areas leading to the kind of action that you are understandably interested in. We do need to do more work, particularly to define and refine in the context of posture and capability, and not in respect to concept. There doesn't seem to be much argument in that area at the present time.

THURSTON (LASL): It seems to me that the whole basis of tactical weapons serving as deterrent is relying upon the adversary to be a reasonable chap and not to escalate any further. I recall that the military leaders of another nation, Japan, counted on the United States to be reasonable in peace by mid 1942; however, we weren't reasonable, in their view, and things turned out differently. What options do we have if our adversaries are not reasonable?

YUDKIN: I don't know that I can really answer that. I guess we are counting on our being considerably more perceptive than the individuals you cite, who made mistakes. I realize that is open to a certain amount of challenge too, because we haven't always been perceptive. Undoubtedly we won't always be, but certainly this is an area in which the best judgment we have is going to be applied, the most intense study, the most careful consideration. This is not an area in which rash moves are going to be undertaken. What the options are in case the enemy turns out to be irrational, I suppose is another area for further excursions. I can't answer you effectively today.





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Robert G. Shreffler*
NATO/IS

THE NATO NUCLEAR PLANNING GROUP AND THE TACTICAL USE OF NUCLEAR WEAPONS

My intention this afternoon is to review the political activities in NATO relative to the tactical use of nuclear weapons, and to pass on some thoughts in this regard based on two years of close association with NATO's nuclear activities. During this period I was dealing predominantly with the views and ideas of NATO member countries, and also with those of the NATO Military Authorities. I had a close working relationship with Europeans, many of whom spend much of their time on these nuclear problems. It is with this background of experience that I am making my comments which, however, are frequently personal ones—a point which I want to emphasize since a number of the issues are controversial. I want to stress the political, as opposed to the military, aspect of the problem, though the two are so closely associated and complementary that it is probably meaningless in any general discussion to concentrate totally on one to the exclusion of the other.

I should like to commence by describing briefly the organization and activity of the Nuclear Planning Group or the NPG. This is the principal political organization within NATO commissioned to deal with nuclear matters. Then I want to turn to our major topic, namely, the tactical use of nuclear weapons, and discuss the development of this subject within the NPG.

So let me talk a bit about the formation, structure, and activities of the Nuclear Planning Group. At the outset I think I should point out that the NPG was established to meet a fundamental requirement that results directly from the special nature of nuclear weapons and their treatment in the North Atlantic Alliance. You will appreciate this if you recall that our European allies have placed their defense by nuclear weapons, and thus their security, almost entirely in the hands of the President of the United States. The European Governments have thus delegated essential parts of their responsibility for the security of their nations, and hence a most vital component of their national sovereignty, to another government—a serious step indeed. Out of this delegation to the President of the United States resulted quite naturally the increasing desire on the part of the European countries to be associated with, and have a say in, nuclear planning upon which their national survival may well depend.

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*Now at LASL.

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As far as the description of the NPG is concerned, I think I need only say that it is a group composed of Defense Ministers representing seven member countries. Four of the members—Germany, Italy, United Kingdom, and United States—are permanent. The remaining three seats rotate among the other members of this 15-country Alliance who wish to participate.

These Defense Ministers meet roughly every six months to discuss a wide variety of nuclear matters under the chairmanship of the Secretary General. The Ministers are supported by a staff in their capitals and by their Ambassadors with their staffs at NATO Headquarters in Brussels. The Group may discuss any topic having to do with nuclear weapons; even in the area of weapon design the Nuclear Planning Group Charter invites suggestions for improving our stockpile. Topics of interest are worked on by the entire group, under the discussion leadership of one, or sometimes two, of the Ministers who will give it particular attention.

The obvious objective of the NPG is to address such topics as strategic and tactical use of nuclear weapons, the consultative process that occurs prior to their release, and methods for increasing the role of nonnuclear powers in nuclear planning. However, in my opinion a major success of the Nuclear Planning Group has been the education of its members. There are now centers (admittedly often small) in the NATO capitals and in Brussels which have at least a speaking acquaintance with the subject of nuclear weapons as they would be used in the defense of the Alliance. The importance of this educated block of people is obvious when one comes to grips with the complicated problems with which this nuclear field abounds. Because political control is essential in any use of nuclear weapons, it is also important for the political decision-makers to be educated to a point where they can effectively exercise their political responsibilities. Finally, the education of the political decision-makers is assuming an expanding importance in regard to such essential political issues as the Non-Proliferation Treaty and Strategic Arms Limitation Talks.

Now for the remainder of my time I should like to explore what the Nuclear Planning Group has done vis-à-vis the problem of tactical use of nuclear weapons. In order to do this with any perspective, it is necessary to talk a bit about NATO strategy and the threat posed by the Warsaw Pact.

First, let me talk about NATO strategy. Prior to the end of 1967, this strategy might be considered as one of "massive retaliation"; in December of that year, documents were adopted by the Ministers describing a new strategy of "flexibility in response." Although the documents which spell out these two strategies allow wide latitude of interpretation—particularly the one on flexible response—

the differences are dramatic. With regard to the tactical use of nuclear weapons, it is fair to say that the old strategy of massive retaliation recognized no tactical use before the "strategic exchange," that is to say before the United States had released its strategic force. Under the new strategy of flexibility in response, tactical use before the strategic exchange was stressed as a very likely option.

From this follows an important consequence: according to the old strategy one could be reasonably indifferent to the collateral damage in the light of the chaos produced by the all-out nuclear exchange. However, with the new strategy, the situation is quite different. Release of nuclear weapons for use in situations less than general nuclear war could be highly contingent upon the collateral effects produced.

There are many other aspects of the new strategy that are worthy of note: for example, it is important for NATO to have the capability of meeting a conventional attack by a conventional defense. In my opinion, however, this does not imply that all forces have to be deployed conventionally. Further, the new strategy states that it is important to be able to escalate the war deliberately, having at one's disposal a wide selection of options which permit the aggression to be met and contained close to the border and at the lowest required level of escalation.

Along with the evolution in strategy, we also have a comparable change in the threat posed to NATO Europe by the Warsaw Pact. In particular, the Warsaw Pact has developed a tactical nuclear capability comparable to our own in strength, but of curiously different structure.

Most important is a comparison of the relative conventional force capabilities of NATO versus the Pact. With some exceptions, most would agree that this balance is significantly in the favor of the Warsaw Pact—though it is quite difficult to make a meaningful comparison. Further, the prospects for the future could lead to an even more dismal picture.

As a consequence of these changes in strategy and threat, one would naturally expect changes in the way we carry out our military task. Indeed, particularly in the light of the specific points I have just discussed, one would expect at least a major investigation of the tactical use of nuclear weapons on the battlefield. SACEUR has given assurance of the existence of plans and procedures consistent with the requirements of the new strategy. However, to my knowledge, these plans have never been exposed to the political authorities from whom the release of the nuclear weapons will have to come, and I see a real danger in that the NATO Military Authorities and the political authorities do not see eye to eye in this respect. In practice, it appears to me that heavy emphasis is being given to the conventional battlefield posture and that tactical nuclear warfare is relegated to a secondary and somewhat nebulous role.

It is difficult to quantify this suspected preference for conventional defense and the de-emphasis of the tactical use of nuclear weapons. Certainly, it is rooted in the firebreak philosophy and the associated concern over the escalation of any nuclear war no matter how constrained or limited. It also stems from the conviction (documented in the new strategy) that the most probable conflict with the Warsaw Pact will involve conventional forces engaged on a limited front.

The conventional preference has also been promoted by a concern over the use of relatively high-yield weapons on the battlefield. Unfortunately, the devastating consequences of such use receive wide advertisement by certain delegations and by such organizations as the United Nations and the Western European Union. As a consequence, in the minds of most Europeans there is no significant difference, as far as destruction of substantial parts of NATO Europe is concerned, between the effects produced by general tactical use on the battlefield and all-out strategic war.

This orientation toward conventional force is also motivated by the concern on the part of the United States that if one emphasizes the widespread dependence upon the use of tactical nuclear weapons, the Europeans may react by reducing their conventional forces. This may be so, but the converse may also be true. It may just be possible that some Europeans may look upon a well considered defense based upon the tactical use of nuclear weapons as the meaningful solution to the problem and be more willing to contribute their fair share.

Now a final point: A conventional initial posture might be acceptable if all NATO forces were well trained to fight a tactical nuclear war and were able to rapidly deploy to a nuclear configuration. If they do not have this ability, and I would suggest that they might not, we are faced with possibly violating a fundamental military rule—namely we are basing a military posture upon our expectations of what the enemy might do, not upon what he is capable of doing. Moreover, I would also question that the NATO Military Authorities, just like the political authorities, have any clear concept of how a tactical nuclear war would be fought, despite the fact that we all know that we have been making plans for 20 years.

What I have just described to you is background to support a description of the efforts of the Nuclear Planning Group on the problem of tactical use. Let me develop this subject chronologically. The first discussion really predates the Nuclear Planning Group to its formative period in 1966. A number of papers were presented at that time.

Subsequently in April 1967 at the first meeting of the Nuclear Planning Group in Washington, the Ministers stressed the need to develop a concept for the use of theater nuclear weapons. At that time, however, it was recognized that work on this commission should await the outcome of studies on the tactical use of nuclear weapons in various contingencies. A number of these studies were completed over the next year. The results, in my opinion, were meagre in analysis though rich in supposition, although a SHAPE study of the use of ADM's in Turkey showed great promise for a special problem. General Cowan will discuss this work in some depth, so I will not say more on this subject. Among other things, all of this work indicated that a satisfactory resolution—or even significant contribution—to any of these problems regarding the use of nuclear weapons was most difficult to achieve. However, on the basis of what had been done it was decided to proceed on specific studies leading to the development of political guidelines to the military on the initial phase of the tactical use of nuclear weapons.

Before we discuss this specific study, to which I will hereafter refer by the term "guidelines," may I first say a few words about an alternative approach proposed by the United States. They were keen on setting up further studies leading to the development of a broad concept from which, as it evolved, would be derived specific guidelines to the military. This United States proposal included studies in depth on many of the fundamental aspects of the problem: target acquisition, command and control, release procedures, etc. In my opinion, it was unfortunate that this proposal was rejected by the Nuclear Planning Group for reasons which I don't think are interesting to you. At least it might have been carried along in parallel with the guidelines study.

To get on with the guidelines study, it was decided a year ago last April that Italy, United Kingdom, United States, and Germany should carry out four preliminary studies. Let me say a few words about these studies, all of which, you may bear in mind, were dealing with the initial use of nuclear weapons.

The Italians put forward a paper on atomic demolition munitions. This Italian paper is still incomplete and though some of its views have been incorporated into the guidelines paper that was written subsequently, considerable work remains to be done. I might add that studies on the ADM problem throughout Allied Command Europe are continuing. This is the only weapon system that has received detailed attention by the NPG, and for various reasons it will probably receive much more.

The British submitted a paper on the use of nuclear weapons at sea. This is an important topic though somewhat peripheral to the main thrust of the effort; however, it brought up, among other things, a controversial point, namely, "preconditioned release," which is understood to mean delegation in time of crisis of authority to use nuclear weapons if certain predetermined conditions are fulfilled. Since time is of critical importance for the use of ADM's, similar release arrangements have been proposed for them. Obviously, this issue will come up again in any consideration of the tactical use of nuclear weapons on the battlefield where time is of the essence.

The United States submitted a paper on demonstrative use, which discusses the pros and cons of the initial use of one or a few nuclear weapons with the intention of showing political resolve.

The German paper was entitled "Selective Use of Nuclear Weapons Against Battlefield Targets in a Limited Conflict." It had the most direct application to the development of the guidelines.

These four preliminary documents were discussed by the Ministers at their fourth meeting in Bonn in the fall of 1968, and they commissioned the British and Germans to draft together a tentative guideline document. The initial draft was presented to the Ministers at their last meeting in London three months ago. The Ministers of two of the largest countries in NATO personally devoted many hours to the preparation of this document and I would like to say a few words about it.

Broadly, this initial draft presents a collation of Alliance views on the initial use of nuclear weapons by NATO in order to develop appropriate guidance for the NATO Military Authorities. In my opinion, these are some of its more salient features:

A most important conclusion is that the fundamental objective of initial use will always be political, and that it would represent a basic qualitative change in warfare. The emphasis accorded to military objectives is recognized as secondary and variable with the situation. I think that there is a general political acceptance of this point, though one expects the military to strongly urge for a careful consideration of the implications of this use from their point of view.

A second point has to do with criteria for determining the time for initial employment. The document recognizes two conditions: One might follow the initial use of nuclear weapons by the Warsaw Pact, and I doubt that this condition will provoke much argument; the second might result following a period of conventional fighting. Now in my opinion, the paper begs the basic point, which is that we have no policy on when we should introduce nuclear weapons in the course of this conventional engagement. Let me dwell on this for a moment. If we take forward defense and the sanctity of our border seriously, as given in the current NATO strategy, we probably have no choice but to go nuclear almost immediately. We optimize our possibility of success within reasonable constraints but assume the risk of escalation. In the second extreme, we make every effort to resolve the issue conventionally, with the risk of losing territory which we might never regain and of sacrificing forces to a degree that might leave them incapable of using nuclear weapons in any case. Possibly the only realistic solution lies somewhere in between, so that there would be time for both military and political appraisal of the situation prior to the release of nuclear weapons.

The subject of demonstrative use was dealt with at some length. You will recall that I defined such use as one usually involving a single or a few nuclear weapons with the intention of showing political resolve. There is also a general requirement to minimize the risk of escalation. The types of targets considered vary over the extreme range from no target at all, showing little more than a willingness to detonate a weapon, to the destruction of a significant military target.

The guidelines document deals at length with operational initial use of nuclear weapons. In this regard a statement—three times repeated—is that the most serious problem connected with the tactical use of nuclear weapons is to employ them in a way that is at once militarily effective, which avoids unacceptable damage, and which limits to the minimum the dangers of uncontrolled escalation. The document returns repeatedly to the point that—particularly in a defensive Alliance—one can expect the detonation of an unreasonable share of the nuclear weapons on NATO soil. Depending on the extent of initial use, intensified use of nuclear weapons in the land/air combat area could entail the destruction, rather than the defense, of much of what NATO is aiming to preserve. The reason I stress this point is that I am afraid there is a general tendency to either ignore or minimize the importance of undesirable collateral damage.

This point also leads to my final comment on the substance of this guidelines document. In that part in which the subject of subsequent tactical use was treated, the subject of escalation was considered. The document warned against escalation leading to intensified use limited to a particular area, which could result in unacceptable devastation. To prevent this, it suggested the possibility of extending the use of nuclear weapons to a wider geographical area and deeper into Warsaw Pact territory. This demonstrated NATO's evident readiness, should aggression continue, to escalate the conflict, eventually to all-out nuclear war, if necessary. The concern of some of the Ministers at London was that such an approach allowed for too few steps or options along the escalation path. Unquestionably this was an issue of fundamental importance. In any case it possibly awakened the Alliance, particularly the United States, to a dilemma. On the one hand, they were faced by a rapid escalation which could require an early commitment of strategic forces; on the other hand, to expose meaningful options, they were faced with a more serious consideration of the tactical use of nuclear weapons. This could represent a substantial departure from the present conventional thinking.

May I add a personal comment on the one alternative, namely, the escalation to all-out nuclear war. In my opinion, in the context of an engagement on the nuclear battlefield, it is not realistic to consider the release of our worldwide strategic capability as a meaningful planning option. It is just not within my comprehension to imagine a situation where the President might give such orders as the result of any battlefield engagement. The fact that this option is maintained permits both military and political planners to too quickly adopt it as a solution, and consequently not face up to the complex task of how one would engage in a nuclear war on the battlefield. The guideline paper offers a good example in point. Let me hasten to add that this is not to detract in any way from the essential importance of this strategic capability to deter the Soviet Union from precipitating a strategic exchange.

This guidelines document was reviewed by the Defense Ministers in London. They invited the British and Germans to refine it in light of their discussion and taking into account the written comment to be supplied by the other governments and the military authorities. This process is now nearly finished in preparation for the November meeting of the NPG in Washington.

It is, of course, not known how this document will be further elaborated and evaluated. However, with something like certainty one can say that it will at some time be approved in some form or other by the Alliance as an extension of our NATO strategy. The draft guideline document has forced people to think very hard about the real issues involved in the tactical use of nuclear weapons in Europe. My hope is that a substantial and constructive document will ultimately result. It is quite important to NATO that such an objective be achieved.

In an effort to ensure the ultimate success in these matters, the Ministers in London commissioned the elaboration of terms of reference for a longer-range program which, in my mind, would follow the approach of the one envisaged in the United States concept proposal that I have already described. This program would constitute the major thrust of future Nuclear Planning Group activity. Work on these terms of reference is under way. It may include a broad study program with a specific mandate for the initial steps.

Now let me add a few words about certain efforts of the Secretary General. He has written two documents which go to the very heart of the guideline problem. In fact, they were written in an effort to circumvent possible problems posed by a premature publication of the guidelines.

The first document was published some time ago and had to do with modernizing our nuclear weapon stockpile. The Secretary General's grave concern was that our present weapons were described to be of such high yield and were to be used in such fashion as to produce collateral effects unacceptable to the Europeans. The ultimate consequence could be the conclusion that there was only limited utility for nuclear weapons in the European theater, and the rejection of the NATO tactical nuclear capability which, in his opinion, was politically unacceptable. The document proposed that we investigate new accurately delivered weapons with substantially lower yields. It outlined a simple work program, one understandable to the NATO political decision-maker. It argued that such an improved capability, which would meet the demands of a constraints policy acceptable to the Europeans, would add a new dimension to the exercise.

Somewhat later, a second paper by the Secretary General considered the events which might take place following a conventional Warsaw Pact attack of such magnitude that we would be forced to resort to the tactical use of nuclear weapons.

With our present force the result recorded by the British and Germans in their draft guidelines was anticipated, namely, a rapid escalation of the nuclear war, primarily because the use of more than a few weapons could result in unacceptable collateral damage.

It was proposed that an improved NATO force capable of fighting with nuclear weapons of lower yield within acceptable constraints and capable of containing any conventional attack would have several additional advantages. In the first place, the enemy would be reluctant to mass his force as a target for a NATO force that had been structured and trained to fight a nuclear engagement. Secondly, were the conventional attack to take place, this improved force would offer a greater range of options to meet any escalation of the engagement. All of these advantages can be summarized in the fact that NATO's deterrent would be substantially improved.

These proposals of the Secretary General, which may now hopefully be encompassed within the follow-on study which I have just mentioned, lead to some difficult questions—questions such as, "How should our forces be structured and deployed in both peace and various stages of war? In more drastic words, should not at least part of our forces be structured and deployed for a nuclear war from the outset? What would be the consequent optimum mix and number of nuclear weapons? What is the trade-off in investment between nuclear force and conventional force and what are their relative advantages?" Hopefully the Nuclear Planning Group will face and resolve questions of this kind in due course.

In the last half hour I have attempted to present my impression of how the NPG is attempting to come to grips with the problem of tactical use of nuclear weapons in Europe. In the process I hope that I have not been overly optimistic in leading you to the conclusion that everything is proceeding in the best possible manner, and that, given sufficient time these problems will be resolved. Frankly I seriously consider this as a possibility, but I would be less than candid if I were to conclude on such a gay note. There is another possibility—unfortunately it may be the more realistic one. It may be that the British and Germans will revise their paper to their own satisfaction, to the satisfaction of the United States, and to the general agreement of all concerned. The final document may be quickly agreed to by the NATO authorities and the matter may come to rest at that point. There may be no more than a token evaluation or implementation of the document; there may be no serious follow-on investigation; and the ADM exercise may be allowed to fizzle along to a bland conclusion. Such a dismal solution could also be narrated for the other NATO nuclear problems, which I have not discussed. The conclusion would be that we would end up in the general region of where we started. In my opinion this would be a tragedy.

Question and Answer Period

COGGAN (North Am. Rockwell): One part of this review disturbs me. I don't detect in the NPG background any deep study of the motivations of the USSR. From such a study one might make a more realistic deduction as to what methodology they may employ in creating or implementing a real threat. Has that been addressed to any depth in this operation?

SHREFFLER: Yes. This might be, for example, a Warsaw Pact first use of nuclear weapons. Such an exercise has been carried out.

COGGAN: Perhaps I am not making myself clear. For instance, here are various countries like Germany, Italy, etc., preparing papers. There are some very knotty problems in the backgrounds of those papers, I am sure. I think to most people who have studied the history of the situation, it is obvious that Russia does not want a reunited Germany, and that is a thorny point in itself for the Germans to face. Is that particular item, for example, really addressed in a constructive manner in the light of how it might influence the actions of the Pact countries?

SHREFFLER: I think the answer is "No." That might well disturb you. You might have another example, but the answer to that is certainly "No."

McDONALD (LRL): I am impressed by your statement and the others today about political impacts of trying to deal with the NATO Alliance. When these things are discussed with them, are they made aware of the possibilities for new weapon technologies that might present them with more acceptable weapons than the classes that they are presently told they must deal with? For example, the thing that comes immediately to mind is the possibility of suppressed radiation systems or things like this. Are they made aware of these things or are they only told about the class of weapons that already exist in the stockpile?

SHREFFLER: I don't think there is an attempt to completely expose all the technology. I think some fraction of it is exposed. For example, General Burchinal spelled out the details of what we might expect for a new ADM. That kind of detail, I think it is fair to say, is not spelled out in the Nuclear Planning Group.

McDONALD: What I am trying to address here is the political acceptability to the Europeans of actually using nuclear weapons on their territory. It has been pointed out to us two or three times today that it is a very strategic war to them when the bombs are going off on their own territory. I am interested, particularly as a weapons designer, in learning how we might make weapons that are more politically acceptable to these people. Have they, in turn, been apprised of these possibilities?

SHREFFLER: I think there is no "Yes" or "No" answer to your question. General Cowan is going to address the ADM problem in a moment. I think the constraints he faced in his exercise were to use the existing stockpile. I think this was a great mistake, myself. Clearly, one of the advantages in doing the study that he carried out would have been to make recommendations on precisely the point you are talking about. Such recommendations, to my recollection, were not made. There is now a frame of reference being outlined for other ADM studies. It again will address the ADM's currently in stockpile, but the door is left open, I think, to consider the kinds of things you are talking about.

WALSKE (DOD): I think I disagree with your implication that the US government has a positive restriction on passing to our allies any advanced technology that hasn't reached a certain stage of development. Until we make the decision that we are ready to develop something, we withhold it for a very good reason—we are not interested in exciting our allies about it so they will come knocking on our door and help us make the decision. Secondly, I'd like to be sure that you agree that we give no internal nuclear design details to our allies. The information they do get is about external characteristics, weight, shape, yield, fission yield perhaps, and this sort of thing.

SHREFFLER: Yes, I'd certainly confirm what you are saying.

REP. HOLIFIELD (JCAE): I believe you said we have been working at this NATO thing for 20 years—and I have been supporting it politically for 20 years. You said that in 1966 we started talking with our allies about possible ways in which we might use nuclear weapons. My first question would be, "Why did we wait 17 years to talk about the fundamental policy of utilization of nuclear weapons by NATO?".

SHREFFLER: I think there certainly have been attempts on the part of the United States to work our NATO allies into the nuclear exercise; but clearly nothing like the Nuclear Planning Group was ever done before.

REP. HOLIFIELD: I am aware of that fact, because I was one of those who advocated the forming of the Nuclear Planning Group, along with some of my colleagues on the Joint Committee. The basic purpose in forming the Planning Group, as I understood it, was to find out under what conditions our allies in NATO would be willing to call down nuclear fire power upon themselves in defending their country. It is apparent that there is a great reluctance on their part—and I can understand it—to predetermine any situation in which they would agree to the use of atomic weapons either by NATO or by the United States. Is that not true?

SHREFFLER: Yes, clearly that is the point.

REP. HOLIFIELD: DELETED It is generally conceded today that there would not be a nuclear attack by the Soviet Union, but probably a massive conventional type of invasion by the Warsaw Pact. DELETED

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SHREFFLER: I think that is the problem we are agonizing over at the present time. One of the tasks facing the Nuclear Planning Group is to educate our nuclear allies to realize the kind of devastation that is really associated with nuclear weapons.

REP. HOLIFIELD: The more we educate them, the less stomach they have for it.

SHREFFLER: I don't think that is necessarily so. I think we should wait and see the results of the guideline document. It will be interesting to see how it evolves.

REP. HOLIFIELD: I have been waiting 20 years; I don't see why I should wait another year or two.

SHREFFLER: I trust that you will. I would only say that our NATO allies didn't have the opportunity of working with the Nuclear Planning Group until you, among others, decided it should be formed. Hopefully, as time goes on and they are forced to face up to these issues more intelligently, the conclusion that you drew may well change; I sincerely hope it does. This gets you back to the thrust of the Secretary General's memorandum on this point. He was concerned that nuclear weapons were incorrectly represented in Europe—not that the military necessarily used them that way. This, along with a number of other points, I think must be corrected.

REP. HOLIFIELD: We have discussed why we do not give our NATO allies some of the advanced capabilities of advanced weapons. I would say that, even though we might have a suppressed radiation type of weapon to use upon the enemy, that would not in any way insure that the enemy would use a suppressed radiation type of weapon on us. Therefore, the fact that we might have such a weapon should have no bearing upon any decision that the Europeans might make, because we would have no way of guaranteeing them that a "pleasant" type of weapon would be sent to us in return.

HAMPTON (OSD ISA): We are closely involved in the work of the Nuclear Planning Group. May I say that the Europeans do not oppose the use of nuclear weapons; they advocate the very early use of nuclear weapons far more than we do from a national standpoint. Their chief concern is that we, as the US, will want to use these weapons only on NATO territory. As a result of the discussions in May, where Secretary Laird made some points very clearly, we have a greater understanding on the part of the Europeans and, we think, more willing cooperation. We are very hopeful that we will be able to reach some sort of agreement with them, either this fall or next spring.

SHREFFLER: Thank you, General Hampton. I would agree with your remarks.

SALET (US Mission to NATO): I think there has been a distinct impression that the new strategy indicates a conventional strategy to the end—and this is not what the new strategy says by any means. The US position in the NPG has been partly to impress on our NATO allies that they have much more in the way of a conventional capability than would initially appear. I think the problem is that the

Europeans have been advocating early use, whereas the US has been advocating much later use in the hopes that the conventional capabilities that do exist are fully exploited. DELETED I think, too, that we will find, as a result of the present discussions on the UK FRG guidelines paper, a considerable shift in European attitudes, particularly among the Germans. There may be some disappointment in the use of mini-nucs because it is going to take many more mini-nucs, with resultant collateral damage.

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SHREFFLER: I guess the only point I would argue is that I am in love with mini-nucs. I don't think that is necessarily so. I think that it is quite important that we explore every possibility to find out how we solve the problem. I don't think we have explored all the possibilities.

SALET: There is one other aspect, that I think lends credence to your statement, and that is, we are preparing to brief the NATO Ministers and the military committee on our improved conventional munitions, as an example. To answer the question that was posed earlier, we are bringing them into this sort of thing so that they have a greater understanding of what is available from a technological point of view.

ARMBRUSTER (Hudson Inst.): May I point out that the Warsaw Pact nations have this problem also, concerning tactical nuclear wars to be fought in East Germany and West Germany. I would like to ask whether the speaker has any feeling for what conversations, if any, are going on in regard to the use of nuclear weapons on the other side of the Curtain?

SHREFFLER: I have no information on that at all.

HOERLIN (LASL): In case of a new serious conflict in the Middle East, which may well involve NATO countries or part of the NATO forces, is there any formal planning on the part of NATO so far as strategic forces are concerned?

SHREFFLER: None, to my knowledge.

HOERLIN: Is it of concern to NATO?

SHREFFLER: Clearly the Mediterranean area is of vital interest to NATO, but I have never heard this subject discussed in the context of nuclear weapons.

SCHNEIDER (Dept. of Navy): I believe you commented that the President would be, in your mind, hard pressed to use any or all of his strategic capabilities in case there was a battle. War, I think, always takes place in theaters, and battles take place in theaters. I am not just sure what you meant by that—losing the battle might lose the theater, and losing the theater might lose the war. Are we to lose the war because the President would not use this capability that he might have left in reserve?

SHREFFLER: The strategic capability? You appreciate that I said I didn't think it was a good idea to consider the strategic capability as one of the options in planning the nuclear war on the battlefield. This is a personal feeling.

SCHNEIDER: That is what I wanted to know, if that was really what you had in mind. It is a personal feeling leading to the logical conclusion that you might lose that battle, you might lose that theater—and then what? You just accept it?

SHREFFLER: Yes, I think that is a possibility. I think it is an issue you have to face later. But the thing that bothers me about the strategic umbrella problem is the problem we face in the guidelines—the very rapid rush from an initial engagement to the strategic exchange; to me that does not make good sense. We do not address fully the problem of what we might be able to do on the tactical nuclear battlefield.

Brig. General Alvin E. Cowan
USA, 3rd Armored Division

SHAPE STUDIES OF TACTICAL NUCLEAR WEAPONS REQUIREMENTS

Good morning, gentlemen. During the next 45 minutes I will briefly discuss current concepts relating to the role of tactical nuclear weapons in NATO.

The purpose of this briefing is to familiarize you with some of the more recent studies and plans on the tactical employment of nuclear weapons in Allied Command Europe, and to outline briefly SHAPE (see Figure 1) requirements for new and improved tactical nuclear weapons. Weapons requirements have been developed in conjunction with some of these recent studies.

During this briefing I will discuss key points of the following plans and studies:

1. The operational plan for a defensive obstacle system for Eastern Turkey.
2. The USEURCOM study of atomic demolition munitions.
3. Plans for the assessment of ACE tactical nuclear capabilities, using SATAN, during Phase III of the ACE capabilities analysis study.
4. Recent SHAPE studies and recommendations pertaining to tactical air delivered weapons.
5. Future trends affecting tactical nuclear weapons requirements.

I would like to begin with one of the most recent plans relating to the use of tactical nuclear ADM weapons.

SHAPE
VIGILIA PRETIUM LIBERTATIS

Figure 1

The ADM Plan for Eastern Turkey is the short title for the operational plan for a defensive obstacle system for Eastern Turkey. This plan was completed on 15 January 1968.

The purpose of this plan was to prepare a defensive obstacle system, utilizing conventional and nuclear explosives, to obstruct and delay an attack on the eastern frontier of Turkey; and, in relation to the planned defensive obstacle system, to develop specific ADM weapons requirements.

The methodology used in developing the defensive obstacle plan was as follows:

1. An analysis was made of weather and terrain conditions in the Third Turkish Army Area, which includes all of Eastern Turkey.

2. An assessment was made of the Soviet forces which could be expected to move against the Third Turkish Army.
3. An assessment was made of Soviet capabilities to attack in Eastern Turkey.
4. An assessment was made of the forces available to the Third Turkish Army.
5. Analyses were made of Third Turkish Army operational plans of conventional obstacle plans within the Third Turkish Army.
6. Upon completion of these assessments and analyses, a compilation of ADM targets recommended in previous Landsoutheast and Turkish proposals was prepared.
7. To insure validity, a reconnaissance of the Third Turkish Army Area was conducted to evaluate each target selected and to determine if additional targets were required.
8. Subsequently, a revised ADM target list was prepared, based on the reconnaissance of the area to be defended.
9. As a final step, war games were conducted to assess the effectiveness of various plans developed.

The following plans were evaluated for effectiveness during the exercise:

1. The present 25% conventional obstacle capability of the Third Turkish Army.
2. An assumed 100% conventional obstacle capability.
3. The present 25% conventional obstacle capability with ADM weapons integrated into the plan.
4. An assumed 100% conventional obstacle capability with ADM weapons integrated into the plan.

Warning conditions assumed during development of the plan included: (1) attack without warning; (2) three days warning; (3) seven days warning.

The effectiveness of each plan was then evaluated assuming release authorization was received to use ADM's at H-hour (beginning of hostilities); H + 8 hours; H + 24 hours; H + 72 hours; or D + 7 days.

Figure 2 will geographically orient you on the area of the Third Turkish Army; it includes the area bounded on the north by the Black Sea, the entire Turkish-USSR frontier, and the Turkish-Iranian frontier. The area is characterized by rough and high mountains interspersed with steep gorges. Four mountain ranges extend in an east-west direction at an average altitude of 2500 meters.

Figure 3 shows the six avenues of approach for enemy combat forces from the Russian border into the Third Turkish Army Area. The movement of armor, motorized units, and large scale infantry is possible along each approach route.

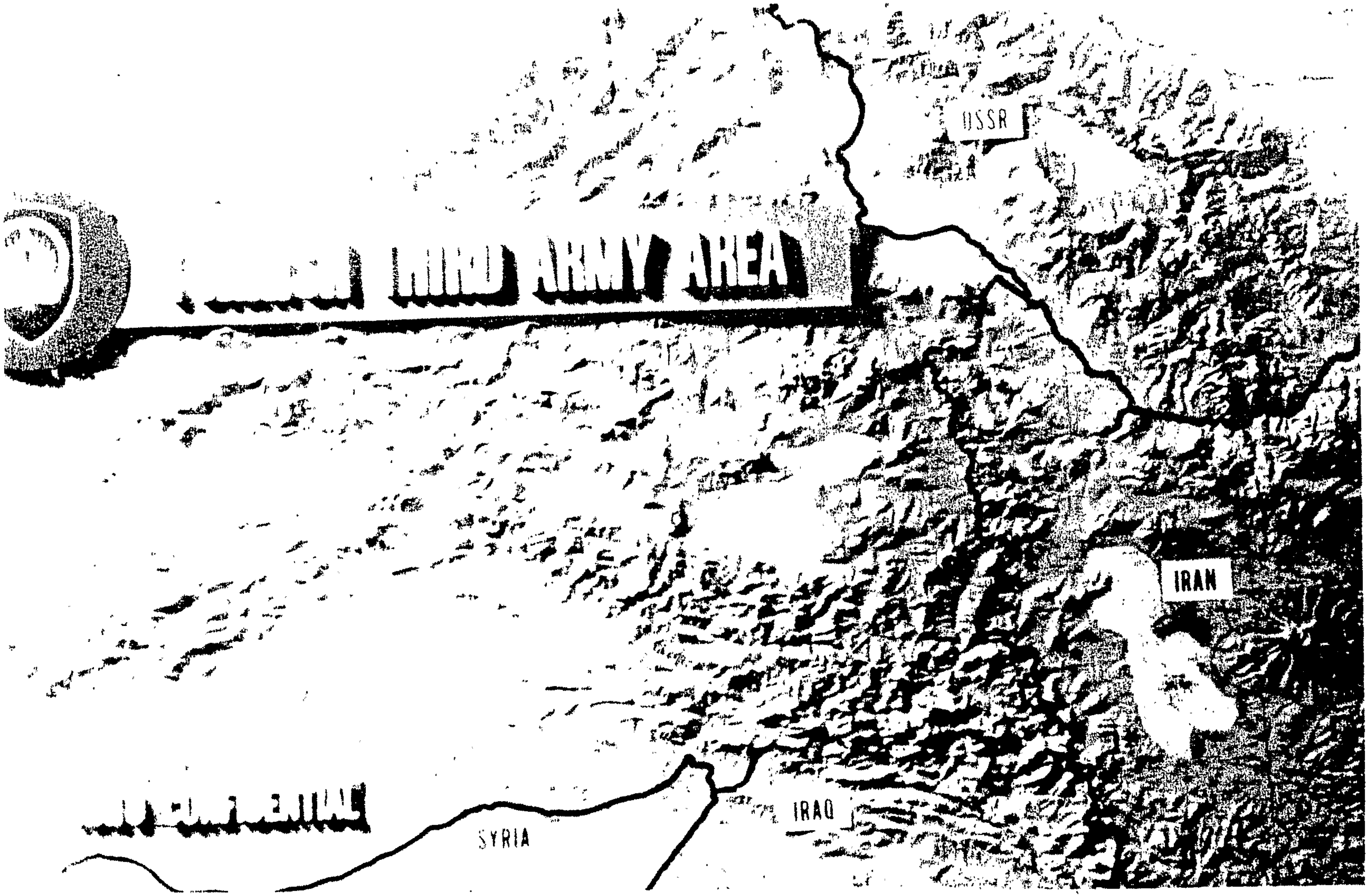

THIRD ARMY AREA
USSR
IRAN
IRAQ
SYRIA
CONFIDENTIAL

Figure 2

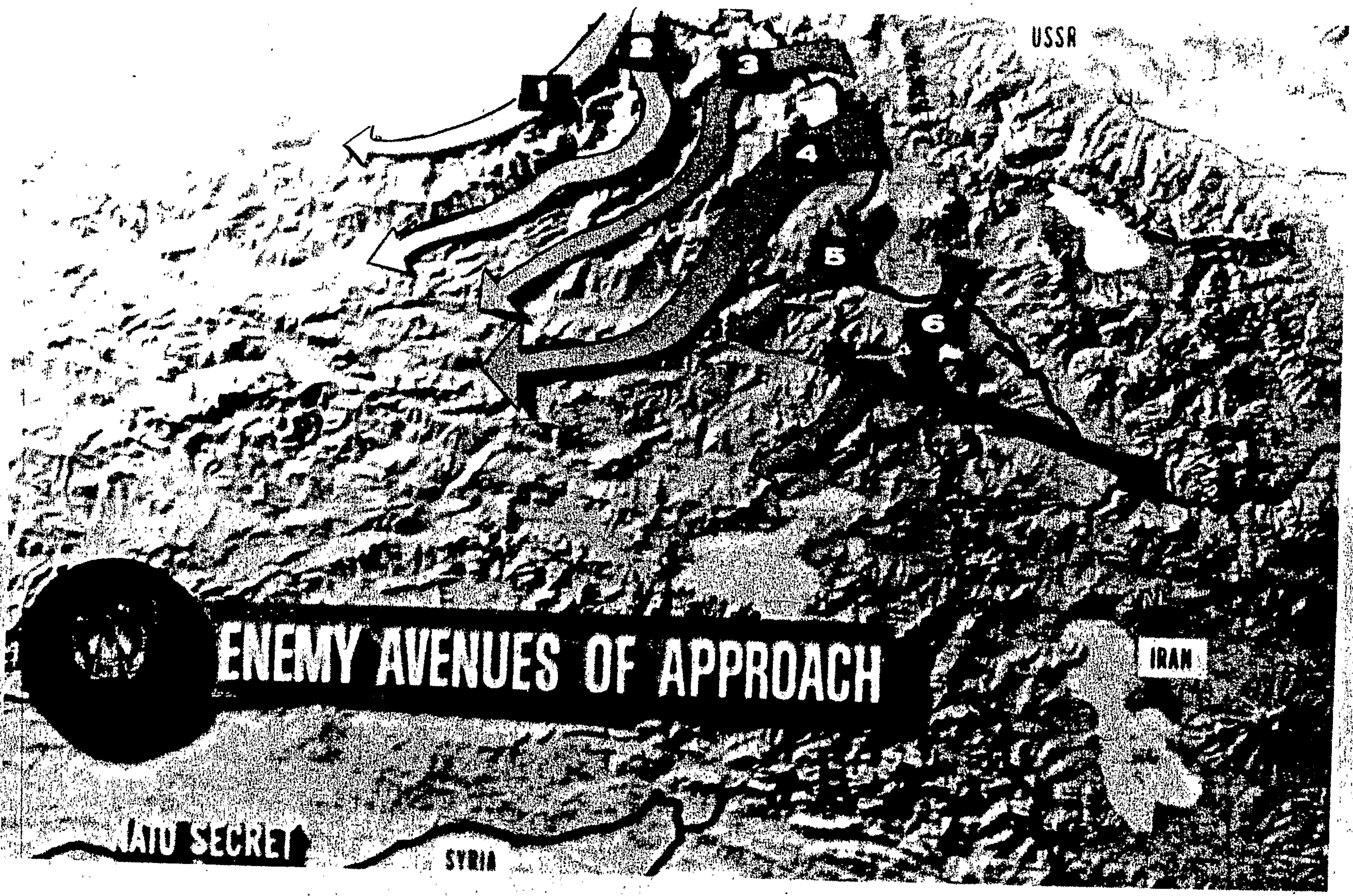

USSR
1
2
3
4
5
6
ENEMY AVENUES OF APPROACH
IRAN
SYRIA
NATO SECRET

Figure 3

Four avenues will support two divisions, the central approach route will support four divisions, and the northern approach will support only a regimental sized attack. The terrain along each avenue of approach contains ideal sites for creating obstacles and delaying the advances of an attacker.

Figure 4

Figure 4 shows a typical approach highway through the mountains in Eastern Turkey. It should be noted that in numerous locations these roads are carved out of the sides of steep mountains.

In addition, Eastern Turkey has a severe winter climate. There is snowfall from October to May, and many of the roads will be impassable to wheeled and tracked vehicles during winter months (see Figure 5).

It was assumed that the USSR forces in the Transcaucasus area have the capability to mount a surprise attack on Eastern Turkey with four motorized rifle divisions and one tank division (see Figure 6). With 72 hours preparation, this force could be increased to five motorized rifle divisions and one tank division. After seven days, the Soviets could attack with six motorized rifle divisions and two tank divisions, and after 30 days, could attack with ten motorized rifle divisions, two tank divisions, and one airborne division. In addition, two naval brigades could make amphibious landings on the Black Sea coast.

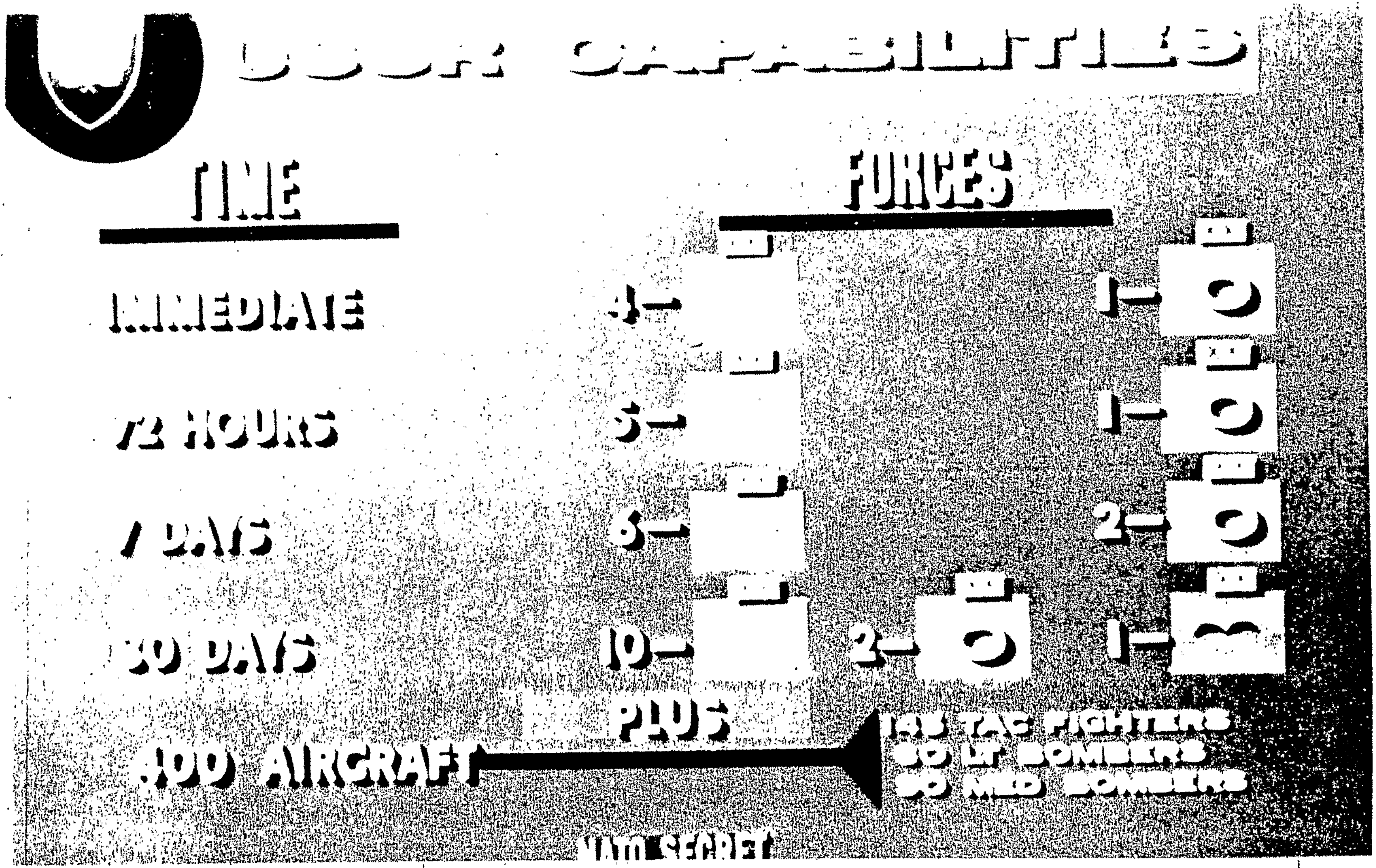
Figure 5

Approximately 400 USSR aircraft were assumed to have been available to support an attack on Eastern Turkey. This included 145 tactical fighters, 60 light bombers, and 90 medium bombers.

The Third Turkish Army, which is responsible for defense of Eastern Turkey, consists of three corps and two separate armored brigades. Two of the corps contain two infantry divisions and one armored cavalry brigade each. The third corps contains one division, one border regiment, and one infantry brigade (see Figure 7).

When deployed for defense of the eastern border, the Third Turkish Army employs two armored cavalry brigades, the border regiment, and six battalions of infantry as screening forces in the vicinity of the border (see Figure 8). The infantry divisions are deployed in main defensive positions approximately 100 km from the border and the two armored brigades are held in reserve.

The three corps of the Third Turkish Army have obstacle plans which include 510 separate conventional obstacles. These obstacles consist of wire entanglements, combined antipersonnel and antitank mine fields, road craters, destroyed bridges, destroyed sections of roads along mountain gorges, and collapsed highway and railroad tunnels.



USSR CAPABILITIES

TIME	FORCES		
IMMEDIATE	4—		1—
72 HOURS	5—		1—
7 DAYS	6—		2—
30 DAYS	10—	2—	1—

PLUS

400 AIRCRAFT

145 TAC FIGHTERS
50 LT BOMBERS
50 MED BOMBERS

NATO SECRET

Figure 6

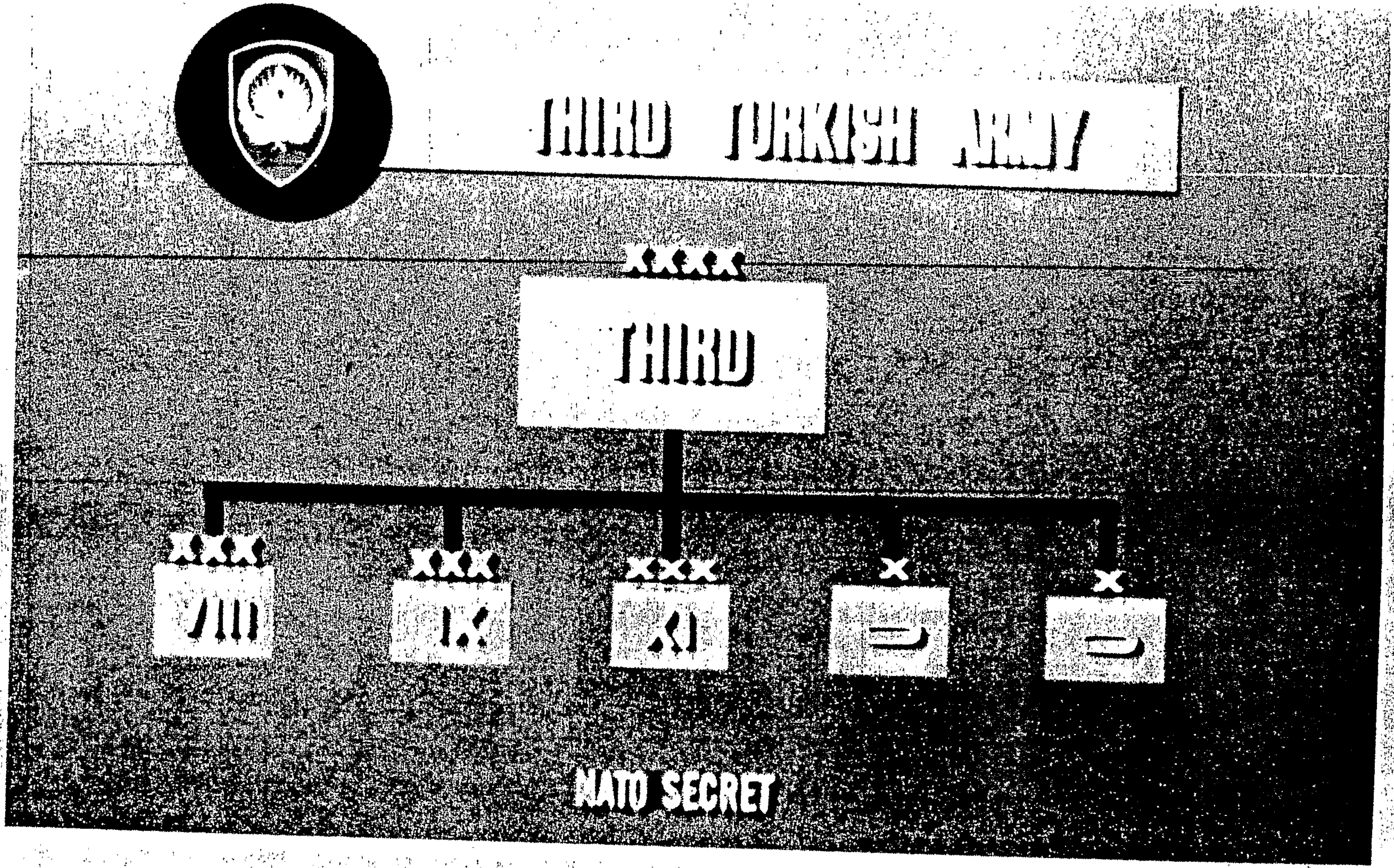
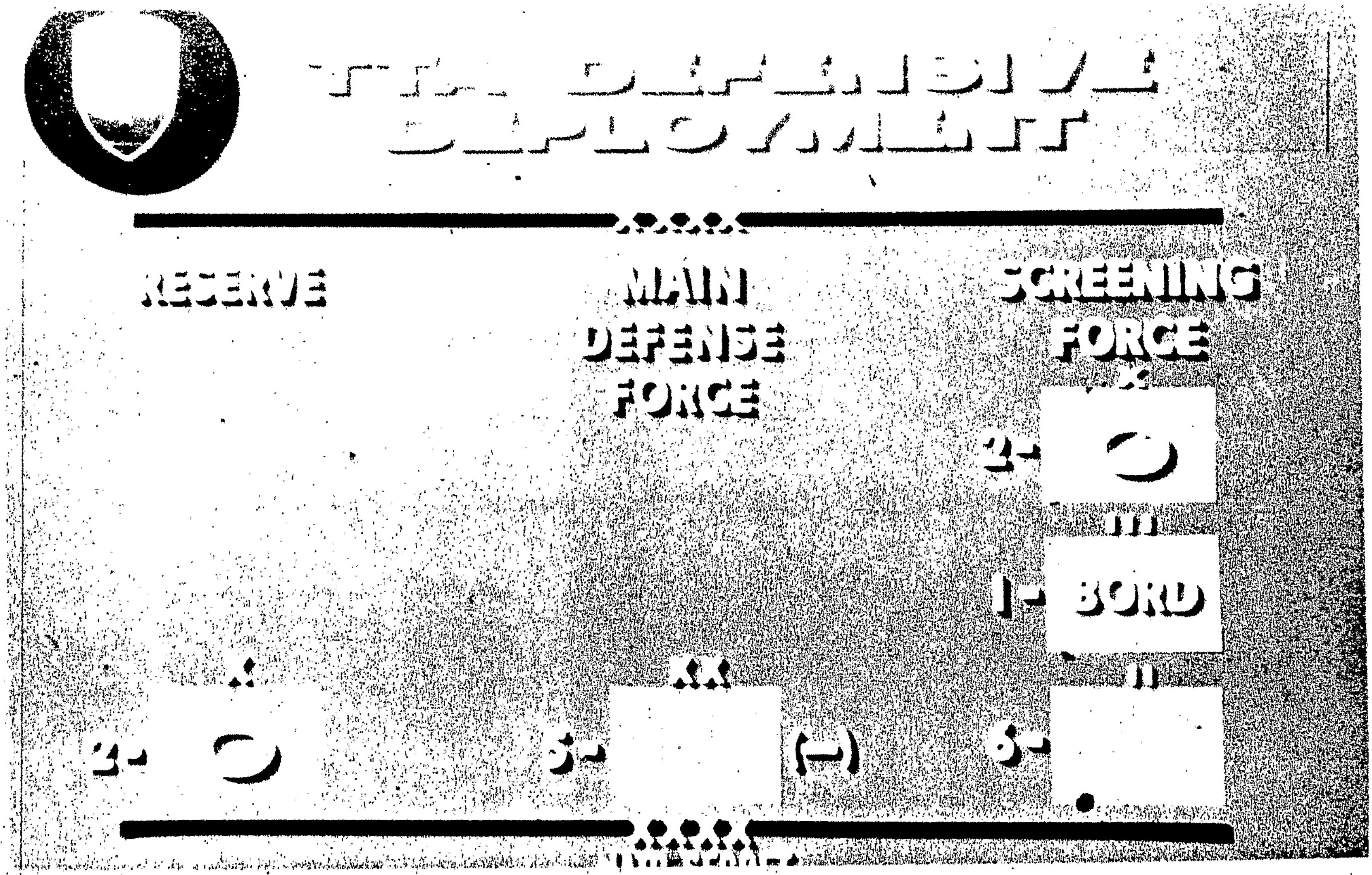

THIRD TURKISH ARMY
XXXX
THIRD
XXX
VIII
XXX
IX
XXX
XI
X
X
NATO SECRET

Figure 7



THE DEFENSIVE DEPLOYMENT

RESERVE

MAIN DEFENSE FORCE

SCREENING FORCE

XX
2-
III
1- BORD
II
6-
XX
5-
(–)
X
2-

Figure 8

The concept of employment of ADM weapons during development of the Turkish obstacle plan was as follows:

1. ADM's were used to supplement existing conventional obstacles by integrating them into existing defense plans.
2. ADM's were targeted to the maximum extent in the area forward of the main battle position to gain maximum delay.
3. For troop safety and to minimize fallout risk, small yield ADM's were targeted within the main defensive position to the maximum extent possible.

Analysis of total ADM requirements for Eastern Turkey, using the concepts previously outlined (see Figure 9), indicated that: 29 ADM weapons of all types were required in the covering force area; 30 weapons were required for protection of the main defensive area; and 13 reserve weapons were required to be held in the rear area for contingency purposes, for a total requirement of 72 ADM's.

Figure 10 shows a comparison of the effectiveness of ADM's and conventional explosives developed through war gaming of the obstacle plan for Eastern Turkey. The chart depicts the manhours and material in kilograms required for the creation of major delay obstacles for roads on hillsides, roads through narrow defiles, and roads through broad defiles. The advantage in delay of ADM's over conventional explosives in terms of manpower and material varied from 8 to 1 in difficult terrain to 2.6 to 1 in rolling terrain.

A cost comparison of the effectiveness of straight conventional obstacle plans and integrated conventional and ADM obstacles for each day of delay gained during defensive operations is shown in Figure 11. The days delay figures were obtained from war gaming. The cost per day of delay was based on initial and 5 year operating costs. The advantage gained over conventional obstacles through the use of ADM's per day of delay varies from 3.4 to 1 for the assumed 100% conventional capability with ADM augmentation to 4 to 1 for the 25% conventional capability with ADM augmentation.

The number of days of delay achieved along each of the six routes of approach considered in the study are shown in Figure 12. The lowest section of the bars shows delay achieved without the use of any obstacles. The next section indicates additional days delay achieved using 25% conventional obstacles. The next section indicates additional delay achieved using 100% conventional obstacles, and the top section indicates additional delay achieved by augmenting the obstacle system with ADM's.

As a matter of interest, the effect of delayed use or receipt of authorization to use ADM's was also evaluated during wargaming of the plan. The average loss of time in delay and the average percentage of effectiveness of ADM's lost through delay is shown in Figure 13. Note that 24 hours' delay in receipt of ADM release authority could result in the loss of 2 days delay and approximately 18% of the effectiveness of ADM's. A delay of 7 days would lose virtually all delay capability and reduce the effectiveness of ADM's by more than 92%.

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COST/EFFECTIVENESS FOR OBSTACLE CONDITIONS

OBSTACLE CONDITION	($ THOUSANDS)	AVERAGE DAYS DELAY	COST PER DAY OF DELAY ($THOUSANDS)
25% CONV	2343	.43	5449
100% CONV	9379	1.58	5936
25% CONV + ADM	15436	11.60	1331
100% CONV + ADM	22472	12.75	1763

Figure 11

DELAY ACHIEVED BY CONVENTIONAL OBSTACLES AND ADM
(72 Hours Warning)

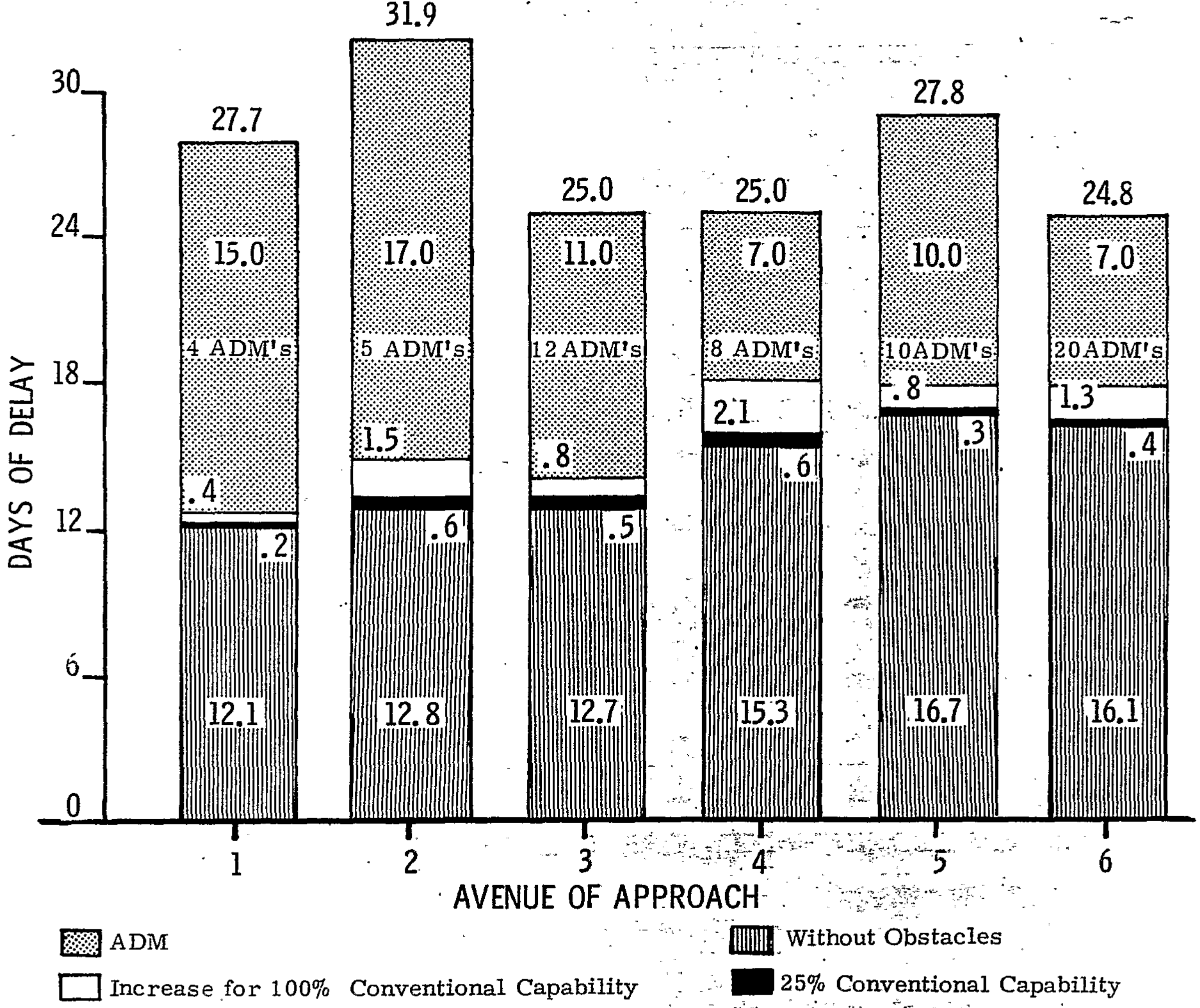

Figure 12

EFFECT OF DELAYED RELEASE OF ADM
25% CONV + ADM

TIME OF EXECUTION	AVERAGE DELAY	% OF ADM
H + 8	0	0
H + 24	2.0	17.9
H + 72	6.83	61.14
D + 7	10.33	92.48

Figure 13

From the ADM plan developed for Eastern Turkey it was concluded that:

1. The area in Eastern Turkey is ideally suited for ADM employment.
2. The ADM would provide significant delay against a USSR advance into Eastern Turkey which could not be achieved by conventional obstacles.
3. The most efficient combination of the four obstacle systems studied in terms of cost and delay is 25% conventional augmented with ADM's.
4. Seventy-two ADM's would be required to provide an effective obstacle plan for Eastern Turkey.
5. Insufficient warning time to conduct civilian evacuation could inhibit the use of ADM's because of fallout risk.
6. The successful execution of the complete obstacle plan is dependent upon timely receipt of authorization to employ ADM's.
7. Finally, an integrated ADM-conventional obstacle plan provides more effective delay, per dollar spent, than entirely conventional obstacle systems or entirely ADM obstacle systems.

I would next like to discuss a study conducted by USEUCOM relating to difficulties in the tactical employment of ADM weapons within NATO. This study was completed and submitted to the Joint Chiefs of Staff on 12 June 1968.

The purpose of the USEUCOM study was:

1. To examine inadequacies in the current ADM family of weapons.
2. To examine the causes and effects of current operational restrictions on the use of ADM weapons.
3. To develop and recommend improved ADM weapon design characteristics.
4. To recommend improved operational employment concepts for ADM's.

ADM weapons presently available to NATO forces within Allied Command Europe include the MADM and SADM. These weapons are presently in custody of US units, and no non-US forces presently have teams trained for the emplacement, preparation, and detonation of ADM's.

The current family of ADM weapons have serious limitations which reduce the effectiveness of their use in the tactical nuclear role. Specifically, these limitations include:

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2. Emplacement and Preparation Time. Burial to sufficient depth to minimize fallout is highly time consuming and, when preemplacement cannot be considered, this becomes a critical factor. Preparation time for firing is equally critical. From a packaged configuration, the MADM requires approximately 2 hours and 45 minutes preparation time. The SADM provides a more realistic 12 minutes preparation time.

3. Radiation and Fallout Hazards. These result from the tactical use of current ADM's, particularly in the hasty emplacement role, and present a major problem of civilian evacuation. This problem further intensifies political objections to the use of ADM's.

4. Firing Options. Although the MADM can be detonated using timer, remote wire, or remote wireless methods, the SADM is limited to timer detonation only. In addition, those MADM weapons positioned for support of non-US forces are limited to the timer option only. Size and weight pose an additional logistical and emplacement problem with current ADM weapons. The present MADM, packaged with equipment, weighs 994 pounds. In an unpackaged configuration, it still weighs 226 pounds. The present SADM weighs a more realistic 132 pounds in a packaged configuration and 60 pounds when unpackaged.

5. Safety and Reliability. Specifically the present PAL locking devices and weapons arming devices are not tamperproof. Also, it would appear that reliability of the warhead, in the environment of a tactical nuclear exchange, can be affected.

Because of these limitations and because of political considerations, severe operational restrictions have been applied to the tactical use of ADM's. These restrictions require that there be no predelegation of authority to utilize ADM weapons; no preemplacement of ADM weapons; and no movement of ADM's forward of the main battle position until authority to release and expend those weapons has been received.

However, the Joint Chiefs of Staff have recently recommended to the Secretary of Defense a revised operational concept which would permit forward tactical positioning of current ADM weapons and preemplacement of the improved ADM currently under development.

Based upon the USEUCOM study and recommendations of US and NATO commanders, numerous recommendations for an improved ADM weapon were submitted to the Joint Chiefs of Staff. The most significant recommendations were:

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2. Increased reliability with no degradation due to battlefield environment.

3. Improved safety and arming features with nuclear yield precluded prior to intentional firing.
4. Simplicity of design and operation requiring minimum time for emplacement and preparation for firing.
5. Size reduction to dimensions not greater than 22 x 48 inches and unpackaged weight not to exceed 75 pounds.
6. Suppressed radiation with minimized fallout effects.
7. Multiple firing options to include remote wireless control capability up to 900 nautical miles with multiple simultaneous detonation capability.
8. Improved rapid burial capability, underground or underwater, to a depth of 60 meters. A 7 day burial capability with power on and an indefinite burial capability with power off is desired, coupled with a remote self-destruct capability.

In addition to improved weapons characteristics, the study recommended numerous improvements in concepts of operations involving the employment of ADM's. The conditions and concepts recommended were:

1. That political agreement and acceptance of the feasibility of using ADM weapons should be sought and secured.
2. Acceptance that ADM's, properly integrated with conventional demolitions and used in a timely manner, provide the most effective defensive obstacle system and should be included in defense planning.
3. That preemplacement of selected ADM weapons during peacetime is feasible, should be authorized, and would greatly facilitate their timely use.
4. That predelegation of authority to use ADM weapons under specific conditions should not be precluded.
5. That a program of cooperation giving non-US forces an ADM capability should be approved and implemented within Allied Command Europe.

Another study which contained a unique approach to planning was the USAREUR Study of Tactical Nuclear Weapons Requirements for 1972 to 1978. This study, developed by USAREUR to determine Central Army Group Requirements, employed the Warsaw Pact division in a building block concept for analyzing weapons requirements. As this study will be presented in detail by the USAREUR representative during the symposium, I will not discuss it in detail. Portions of the USAREUR study were used in determining SHAPE requirements submitted to the Joint Chiefs of Staff on 15 January 1969; however, the concept used by USAREUR is still being evaluated at SHAPE.

I would like now to turn to the ACE Capabilities Analysis Study. What has been termed Phase II of this study is now nearing completion. This is a study of conventional forces only. The present Ad Hoc Study Group may be replaced by a permanent group to provide a computerized analytical capability for further SHAPE studies. If SACEUR so decides, one of the top candidates for Phase III of the study is an assessment of ACE tactical nuclear capabilities using SATAN.

SATAN is an acronym for Simulation for the Assessment of Tactical Nuclear Weapons and is designed for use on the IBM 7090/7094 computer.

SATAN consists of a set of programs that, when presented with two opposing force structures, will automatically select targets, select weapons to fire on those targets, and assess the effects of nuclear fires.

The capabilities of SATAN include the following:

1. The ability to analyze weapons effects on forces varying in size from 2 divisions to a maximum capability of programming for 255 divisions, 80 corps, or 20 armies.
2. Forces may be deployed in any area on a map divided into 10 meter squares. The maximum deployment area is 2621 kilometers square. Targets include groups of men or equipment which are assumed to occupy an area of specific size.
3. Any nuclear weapon system whose operation can be described in terms of yield, range, CEP, height of burst, probable error, time to fire, and abort rate can be programmed in the computer.
4. SATAN simulation can be used to program up to 45 days of consecutive war; however, simulation can be broken into segments of simulated time called cycles.

Limitations of SATAN include the following:

1. The use and effects of conventional, chemical, and biological weapons cannot be simulated by the computer.
2. Localized terrain features and vegetation can not be considered.
3. Procedures for computing radioactive fallout from surface bursts are not included.
4. Air offense and air defense conflict can not be simulated by the computer.
5. Within simulation cycles, units maintain static deployment, except for movement as a result of counter battery fire.
6. The model considers only military troop formations and tanks, APC's, or artillery pieces.
7. And finally, operations and intelligence processes can not be simulated with SATAN.

Phase III, if conducted, should provide SACEUR with a useful assessment of current ACE tactical nuclear capabilities within the scope of the foregoing limitations.

To broaden the spectrum of my discussion of tactical nuclear weapons requirements within Allied Command Europe, I would like briefly to discuss studies and requirements for air delivered weapons systems.

Recent studies conducted by SHAPE relating to air delivered weapons concluded that requirements existed for a low drag bomb, an air-to-surface missile, and a standoff air-to-surface missile.

The purpose of the low drag bomb is to increase the range and supersonic capability of strike aircraft through reduced drag effects. The desired yields would be selectable 20-30 kt or 100-130 kt. The bomb is required for the conduct of longer range strikes against hardened Warsaw Pact airfields, close air support of the land battle, air superiority, and air interdiction purposes.

An air-to-surface nuclear capable missile has also been stated as a requirement by SHAPE. One of the main purposes of this system would be to provide highly accurate close air support of the land battle. A low yield of 10-100 tons is desired for this weapon to conform to its proposed employment in the proximity of the FEBA, to permit aircraft to conduct effective strikes against highly mobile targets during conduct of the land battle, and to minimize collateral damage in attacking targets near population centers, particularly in the satellites.

In addition, a standoff air-to-surface nuclear capable missile has been submitted as a requirement. The purpose of the standoff ASM is to enhance the survivability of strike aircraft. A selectable yield of 10-100 kt with a range capability of 500 nautical miles is desired in this weapon. The standoff ASM is required to permit effective long range strikes against radars, SAM sites, antiaircraft complexes, and ABM sites.

Future requirements for tactical nuclear weapons within NATO will, of necessity, be influenced by political and military considerations. For example, there has been evidence of increasing interest in very low yield tactical nuclear weapons within NATO; however, no definite conclusions have been drawn regarding the desirability or effects of increasing the ratio of low yield tactical weapons in the ACE nuclear stockpile, and no positive action to modify the weapons mix has been initiated.

The NATO Nuclear Planning Group has suggested that tactical nuclear weapons be identified by the following categories:

1. Low yield weapons including those with a nominal yield of 10 tons equivalent and those up to 100 tons equivalent.
2. Medium yield weapons, having a nominal yield between 100 tons and 10 kt equivalent.
3. High yield weapons, including all yields above 10 kt.

Contributing to this increased interest in lower yield nuclear weapons has been fear, by the Federal Republic of Germany, of collateral damage in the event of tactical nuclear war and the concept that increasing the accuracy of new weapons systems would permit effective strikes against tactical targets using smaller nuclear yields.

Although these factors can be expected to influence political thinking, the NPG has not stated a precise suggestion for the composition of a revised tactical nuclear weapons stockpile for Allied Command Europe.

The most significant military considerations affecting the tactical employment of nuclear weapons in NATO relate to current constraints on the use of weapons, rather than on weapon yield and design, specifically:

1. There is no preconditioned release authority for the use of any tactical nuclear weapons.
2. There is no authority to pre-position defensive tactical nuclear weapons such as ADM's.

While it would undoubtedly facilitate military operations to have preconditioned release authority, there have never been any indications that obtaining such authority would be politically feasible. However, pre-positioning of ADM weapons is desirable and should be politically feasible if a new type ADM were developed with characteristics that would permit remote controlled operations in a buried configuration.

Military arguments for the pre-positioning of ADM weapons are based on: (1) the time required to move ADM's from present storage sites or field storage locations to selected target sites; and (2) the time required to bury and emplace ADM's to minimize fallout and achieve maximum tactical results from the weapon explosion.

Considerations which oppose the concept of preemplacement include (1) the design limitations of current ADM weapons; (2) the cost associated with prechambering selected sites; and (3) the psychological impact on the civilian population in those areas selected for prechambering.

Certain members of the Alliance have, quite properly, shown an increasing interest in low yield tactical nuclear weapons, and this could develop into an increased demand for low yield weapons in NATO. Surely, any military commander would favor a low yield weapon over one of high yield, so long as the combination of yield and delivery accuracy are sufficient to accomplish the task for which the weapons are earmarked. Such weapons would give him more flexibility in the application of his available firepower. However, this does not mean that he would favor such a trade-off across the board. To do so could lead to the very dangerous circumstance of being badly outgunned—and the implications of such a situation are quite obvious.

Question and Answer Period

REP. HOSMER (JCAE): It has been rumored that the Turkish ADM deal was turned off when the Soviets informed the Turks that they would not sit still for it. Is there anything to that?

COWAN: I am sorry, sir, I don't know if that is the case. I have heard the speculation, but I don't have any concrete evidence within NATO to substantiate this.

WALSKE (DOD): Regarding the 900 mile remote control capability on ADM's, people who have been working on the Phase II will recognize that that was not requested by DDR&E. That wasn't strictly a civilian decision. Some of those, even in the Army, weren't enthusiastic about it in quite the same way as EUCOM. That is just a comment. With regard to the question of release authority on ADM's, your information was correct up until the first of the year, and was certainly correct during the Turkish ADM study. About that time, though, new US guidance came out on ADM's and I might just mention it so that people will have the right idea. It does affect weapon design under some circumstances, perhaps. The first point is that ADM's may be positioned upon military decision ("positioned" means moved out of theater storage, moved any place in the theater) so long as proper security and custody by the US is maintained. That means if release authority to use the ADM's is not given, it must be possible to withdraw the ADM's without losing them to the opposing forces. So positioning may be done on a military decision. Emplacement requires the consent of the National Command Authority. Emplacement, by implication, means putting the ADM's in the ground so you don't necessarily have the capability of getting them out in time if the enemy comes and you have not decided to use them. Finally, release of them for use again must be approved by the National Command Authority; and the policy also says that it may be possible to get emplacement authority from the National Command Authority prior to getting release authority. This means that, in a developing crisis, the President could, if he chose, exercise the option of actually emplacing an ADM, and then have the authority to either use it or sacrifice it to the enemy. Either way, it would have to be a Presidential decision.

COWAN: Let's clear this up. Have we released this to our NATO allies or have we held this in US channels?

WALSKE: It was released in the NATO circles a few months after it was generated and not actually incorporated in NATO ADM studies. We have made some progress in that area.

COWAN: I am delighted to hear it. I am sorry the staff didn't know it. I would also say we have a communication gap on this 900 mile requirement.

FOWLER (DDR&E): In the Turkey scenario, you limited the invasion possibilities to the six overland passes through the mountains. How practical is it to invade Turkey by way of the Black Sea?

COWAN: I don't know, nor do I recall from the Intelligence exactly what the enemy's amphibious capability via the Black Sea would be. However, my recollection is that it was extremely limited and that he would be most vulnerable if he attempted it by that route. There are several reasons for this: one, the logistics problems are great; secondly, the terrain is difficult; the mountains generally rise right out of the Black Sea and the invader is immediately confronted with scaling those and trying to establish himself in that area. The Turks are excellent mountain fighters and I'd say they would give him a good run for his money under any circumstances. We didn't dismiss this possibility, but we thought of it as a possible reinforcing capability for this small force that might elect to proceed down the beach, so to speak, as I showed you on Invasion Route 1.

FOWLER: My other question has to do with the proposed new weapon. It wasn't clear to me what value a low drag bomb had for attacking air fields compared with a lot of other possibilities. And why would you want such a large yield for a close support weapon, particularly when we have precision weapons like Maverick coming up?

COWAN: In answer to your first question on the low drag bomb, on many of the aircraft that we are talking about this weapon will have to be carried as an external store. We want to make sure it has the low drag essential for its carrier. With regard to the second portion of the question, I don't think we considered things like Maverick—and this goes into the release of things that are in development, so to speak, to our NATO allies. To this extent, our studies have perhaps a serious limitation.

ROWNTREE (NWC, China Lake): On your requirement for the air launch standoff weapon, what is the basis for the 500 miles and what kind of CEP's do you require associated with that?

COWAN: The basis for it was the antiaircraft capability which exists immediately on the other side of the Iron Curtain. This becomes very evident if you just examine the situation—thus the standoff capability. The CEP was to be quite accurate for us to attack, hopefully, airfields and shelters. They have, at the present time, a very active shelter program on all of their airfields.

ROWNTREE: So the airfield is really the primary target there, rather than the SAM sites and radars?

COWAN: I think the most vulnerable thing we have in NATO today is the Allied Tactical Air Force. We are confined to a relatively small number of bases—20-odd, I believe—in which we have airplanes (for example, at the US base at Bitburg) wing-tip to wing-tip. There is a limited dispersion that we can do even on that airfield. You think about vertical dispersion or other concepts, but it gets down to the point where the United States has asked NATO for shelter capabilities of its own. We have got to solve the tactical air problem immediately in any war, or else we are going to get pounded to beat sixty. Opposing us, in the Northern Army Groups, there are some 93 airfields just facing NORTAG, for example. So if we tried to put airplanes against each airfield in his dispersal pattern, it gets down to the point that we hardly have enough for one or two per airfield.

ROWNTREE: Can't something like the mobile missile that the general talked about this morning equally well satisfy that requirement—because the hostile airfields are well known. You don't have to strike an airfield from an airplane.

COWAN: Very true, but we haven't been able to get that MRBM for years. We might be able to get the standoff capability on airplanes.

CARTER (DDR&E): You asked again for a suppressed radiation capability, which has been discussed a lot. How clean or how suppressed does it have to be before it really buys you a new capability?

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For example, when you talk to the Germans about placing ADM's along the Fulda Gap, you run up against a sizeable city like Kassel, or the town of Fulda itself. The logical place for these things, it so happens, is in many cases around these cities or other populated areas, so that fallout might be a problem. Further, the German usually knows the family living on the land where he places an ADM. It gets to be a highly personal affair. So anything that will minimize fallout and reduce the danger to the population, we would like to have. We have not, I am afraid, indicated specifically what we want in this, because we really don't know what your state of the art is or what you could obtain for us. We would like to take as much as we could get.

GLASSER (R&D, USAF): Agreeing with you in regard to the relative vulnerabilities of the Allied and Pact Air Forces, what is the SHAPE interest in the V/STOL Tactical Air Force?

COWAN: I'd hate to make a commitment for SACEUR because I have not discussed this problem with the new SACEUR. I will say this: The British, as you know, are going to the Harrier. From our own studies of this, we think V/STOL capability would give us the dispersion characteristics that we desire for survivability. However, I am of the opinion that the cost, both for the aircraft and its supporting materiel and personnel to make it work, would be much higher than for other, more economical means which might achieve the same results.

GARWIN (IBM): I didn't understand your answer to Mr. Rowntree. You said you had been trying for years to get the MRBM and thought that you might have a chance for an air launch standoff weapon. What has held up the MRBM? Is it just difficult to get an agreement that one wants to have a long range land based missile? Or does it have to do with the civilian management or the NATO countries?

COWAN: I'll have to bow to General Burchinal, who discussed that a little bit this morning. Do you want to answer that one, sir?

BURCHINAL (USEURCOM): To my knowledge, the last time a military requirement was forwarded to the office of the Secretary of Defense, the Secretary of Defense ruled that there was no requirement for an MRBM.

COWAN: I think that has been rather consistent.

Lt. Colonel Robert R. Knox
USA CDC-ICAS

CURRENT TACTICAL NUCLEAR WARFARE DOCTRINE AND CDC STUDIES

Gentlemen, this is an information briefing classified SECRET. The purpose is to acquaint you with a Combat Developments Command Project to improve tactical nuclear warfare doctrine. In essence, this project is an investigation into how the Army will fight on the nuclear battlefield, and how it should be organized and equipped to accomplish its mission in this environment. The short title of this project is NUWAR.

Presented during this briefing will be a brief review of the current Army doctrine on nuclear operations; a discussion of earlier studies in this field; and a description of the scope, methodology, and progress of the NUWAR project.

Shortly after the end of World War II, considerations of the impact of nuclear weapons on military operations started to appear in the Army doctrinal manuals. This process has continued until virtually all current doctrinal manuals—except those whose subject is clearly inappropriate, such as counterinsurgency operations—address the problems of nuclear conflict. Typically these manuals have, near the beginning, a short paragraph or section which states that the doctrine outlined is applicable to all levels of combat, and explanatory remarks are inserted throughout the manual where necessary to modify conventional doctrine for nuclear operations.

Figure 1 illustrates the breadth of the manuals that address nuclear doctrine. This is a very abbreviated list of titles. Of all these manuals, only the first is exclusively orientated, by title, toward nuclear weapons employment. Yet within the other manuals, which deal with combat operations from theater through division, brigade, and battalion level, with the attendant combat service support activities, are doctrinal statements on military operations in a nuclear environment.

Found throughout these manuals is a philosophy that the conduct of both nuclear and nonnuclear operations is based on the application of combat power in accordance with the same principles of war. The differences in technique described in each arise from the increased vulnerability of troops and installations in the nuclear environment, and from the measures required to counteract this increased vulnerability.

EXAMPLES OF DOCTRINAL MANUALS

FM 101-31-1	NUCLEAR WEAPONS EMPLOYMENT, DOCTRINE AND PROCEDURES
FM 100-5	OPERATIONS OF ARMY FORCES IN THE FIELD
FM 61-100	THE DIVISION
FM 7-30	INFANTRY, AIRBORNE INFANTRY AND MECHANIZED INFANTRY BRIGADES
FM 7-20	INFANTRY, AIRBORNE INFANTRY AND MECHANIZED INFANTRY BATTALIONS
FM 17-30	THE ARMORED DIVISION/BRIGADE
FM 17-1	ARMOR OPERATIONS
FM 54-2	THE DIVISION SUPPORT COMMAND
FM 54-3	THE FIELD ARMY SUPPORT COMMAND
FM 54-4	THE SUPPORT BRIGADE
FM 54-5-1 (TEST)	THE SUPPLY AND MAINTENANCE COMMAND

Figure 1

In our investigation of these manuals and others we found doctrinal statements in all of the areas shown in Figure 2. In truth, all major activities of the army in the field have been addressed in light of the impact of nuclear weapons on the battlefield. Yet throughout the manuals there is a noticeable lack of specifics. We will have a porous, fluid battlefield; forces will be dispersed; they must be highly mobile and they must be capable of acting independently. It is to the elimination of this lack of specifics that current studies are addressed.

DOCTRINAL AREAS CONSIDERED

1. OFFENSE
2. DEFENSE
3. FIRE SUPPORT
4. COMMAND, CONTROL AND COMMUNICATIONS
5. TARGET ACQUISITION
6. INTELLIGENCE DATA PROCESSING
7. MOBILITY
8. COMBAT SUPPORT
9. COMBAT SERVICE SUPPORT

Figure 2

An earlier study and a subsequent troop test are the immediate forebears of the current NUWAR Program.

The Army in 1963 undertook a comprehensive and deliberate study, known as Oregon Trail, of the uses of nuclear weapons in land warfare. Oregon Trail was completed in February 1965 and recommended new organizations, new equipment, and a doctrine for the use of nuclear weapons in land warfare unlike previous ideas. This system of organizations, weapons, and doctrine was geared for attainment in the period 1968-1972. It relied heavily on battlefield dispersion of self-contained units. It emphasized the attrition nature of two-sided nuclear warfare. It stressed firepower, both nuclear and nonnuclear, and target acquisition, and tended to subordinate maneuver so long as the enemy retained a nuclear capability. It proposed great depth to the defensive position and did not seek to avoid enemy penetration of the spaces between dispersed units. Enemy elements, acquired in these spaces, were promptly taken under fire—either nuclear or nonnuclear. Great reliance was placed upon the 107 mm mortar, improved fragmentation munitions, a conceptual rocket delivery system, forward area air defense systems having passive acquisition means, and an effective antitactical missile and aircraft system.

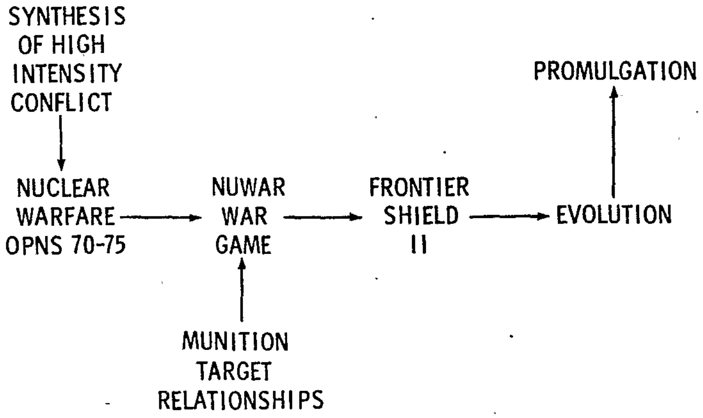
The Department of the Army, in reviewing this study, determined that the revolutionary change in organization was not feasible by the time period 1968-1972 nor did it consider that the conceptual weapons upon which the concept relied were reasonably attainable in that period. On the other hand, the Department of the Army endorsed the concepts of widespread dispersion, great depth, a battle of attrition during two-sided nuclear conflicts, and postponement of decisive maneuver action until the enemy nuclear capability was substantially reduced. The Chief of Staff, Army, directed that these approved concepts be incorporated into a doctrine adaptable to the existing ROAD organization and equipment and that the doctrine be tested in the field.

Troop Test Frontier Shield was conducted in Europe in the winter of 1966-67. While its findings were not decisive, they indicated that the postulated doctrine was not workable with the equipment available and that a major command and control problem exists in implementing the conceptual ideas of Oregon Trail within the Frontier Shield postulated doctrine.

After a review of the findings of Troop Test Frontier Shield, the Department of the Army directed CDC to revise and improve the doctrine of Frontier Shield and to conduct a troop test of the revised doctrine. This direction has led to the development of the current CDC NUWAR project.

As shown in Figure 3, the project consists of some seven tasks: The SHIC Study, which is a synthesis of the data, information, and postulations written on nuclear conflict, plus an extensive bibliography; the MTR Study, an assessment of the comparative utility of nuclear, conventional, and improved conventional weapons against a variety of targets; the development of an exhaustive specific doctrine for nuclear operations; the evaluation of this doctrine by both a war game and a troop test; the modification of the original doctrine in light of the results of the war game and troop test; and finally, the promulgation of this doctrine to the field. The first three tasks have been completed, and the war game is currently in progress.

Neither the proposed doctrine nor the tentative war game results that I will discuss should be considered as reflecting either CDC or Department of the Army approval. In both cases they represent the current thinking at the working level and both are certainly subject to change as the NUWAR project develops.


NUWAR PROJECT RELATIONSHIPS

SYNTHESIS OF HIGH INTENSITY CONFLICT
NUCLEAR WARFARE OPNS 70-75
NUWAR WAR GAME
MUNITION TARGET RELATIONSHIPS
FRONTIER SHIELD II
EVOLUTION
PROMULGATION

Figure 3

Army 75 is a just completed CDC study that will form the basis of the organizational and operational concepts for the Army in the 70-75 time frame. From this study, we chose the heavy division as the model unit for the NUWAR Study. This division is roughly equivalent to the current armored division. Each of its maneuver battalions (four mechanized, five armored) has four letter companies. During war games three defensive and two offensive alternatives are being investigated. In each of the concepts for defense, the division commander plans for enemy penetrations in the forward defense area—and attempts to canalize enemy forces into either preselected or expedient nuclear killing zones. It is expected that a division frontage will range from 35-50 kilometers as shown on Figure 4. Areas for the brigade and battalion are also illustrated.

Associated with the three forms of defense is the concept of imposing an unacceptable level of attrition against enemy units and establishing a redundancy of defensive effort to inflict the desired attrition. Defensively, a modified mobile defense with a brigade or larger reserve is to be tested. Lateral dispersal of units is greater than in the standard formation.

Figure 5 shows a typical dispersion of units across the division front and portrays a division size penetration. Also to be tested is the area defense with certain modifications—one of which is no designated reserve force. In this concept, uncommitted units may be deployed to blunt enemy penetrations as shown in Figure 6, or several units may be massed to mount a counterattack if the tactical situation dictates.

TYPICAL FRONTAGES

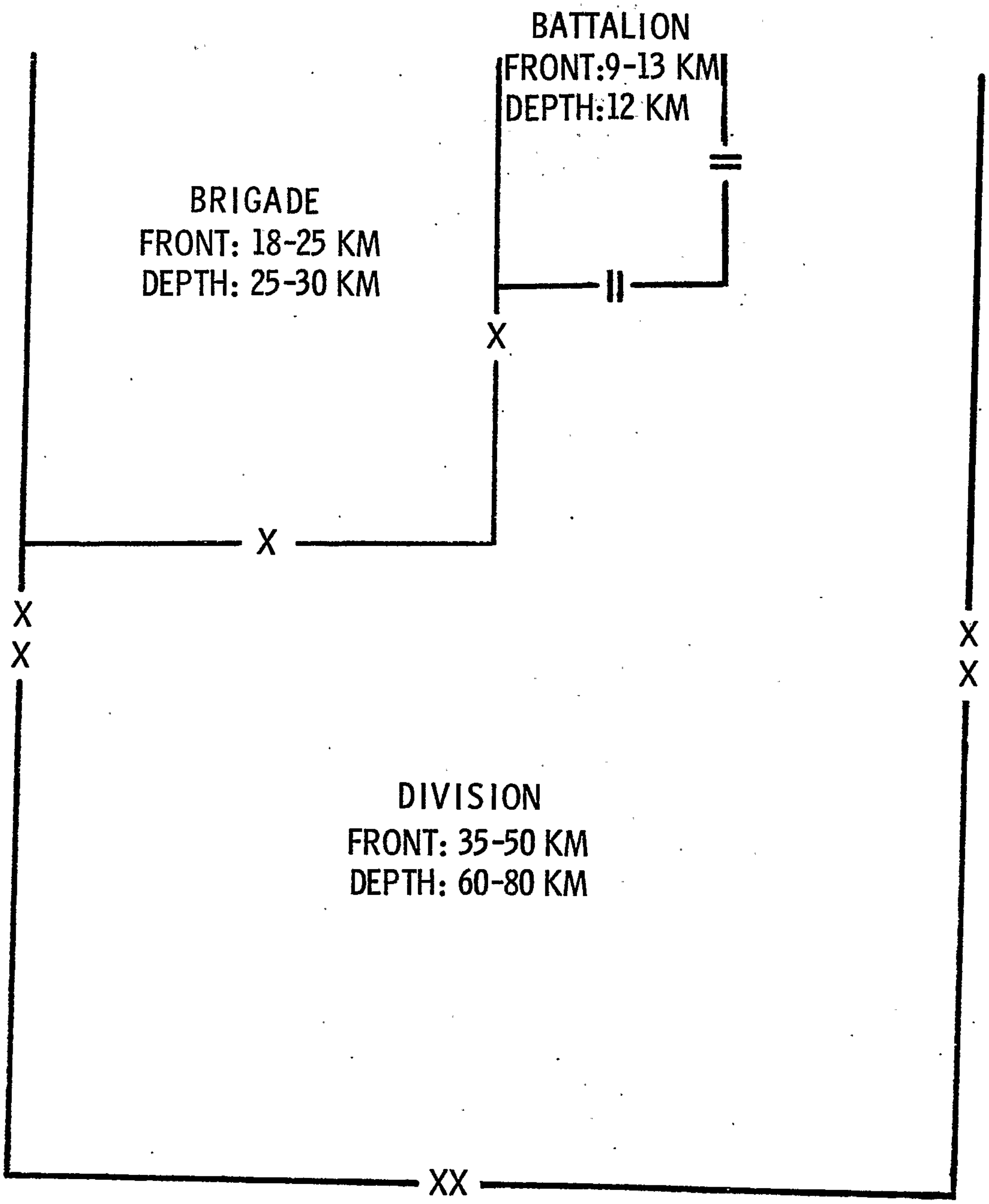

BATTALION
FRONT:9-13 KM
DEPTH:12 KM
=
II
BRIGADE
FRONT: 18-25 KM
DEPTH: 25-30 KM
X
X
XX
XX
DIVISION
FRONT: 35-50 KM
DEPTH: 60-80 KM
XX

Figure 4

MOBILE DEFENSE WITH PENETRATION

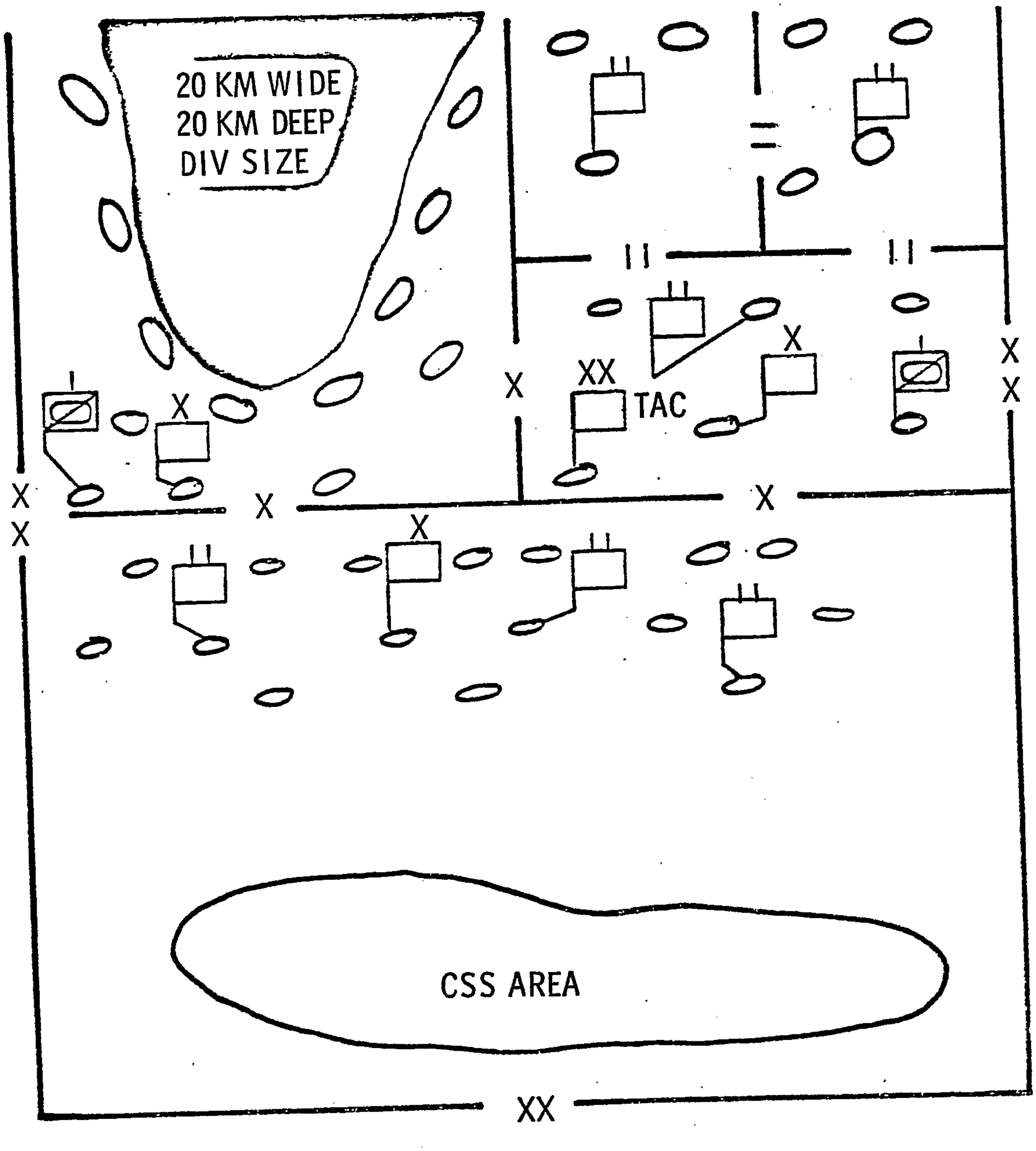

20 KM WIDE
20 KM DEEP
DIV SIZE
X
XX
TAC
II
XX
CSS AREA

Figure 5

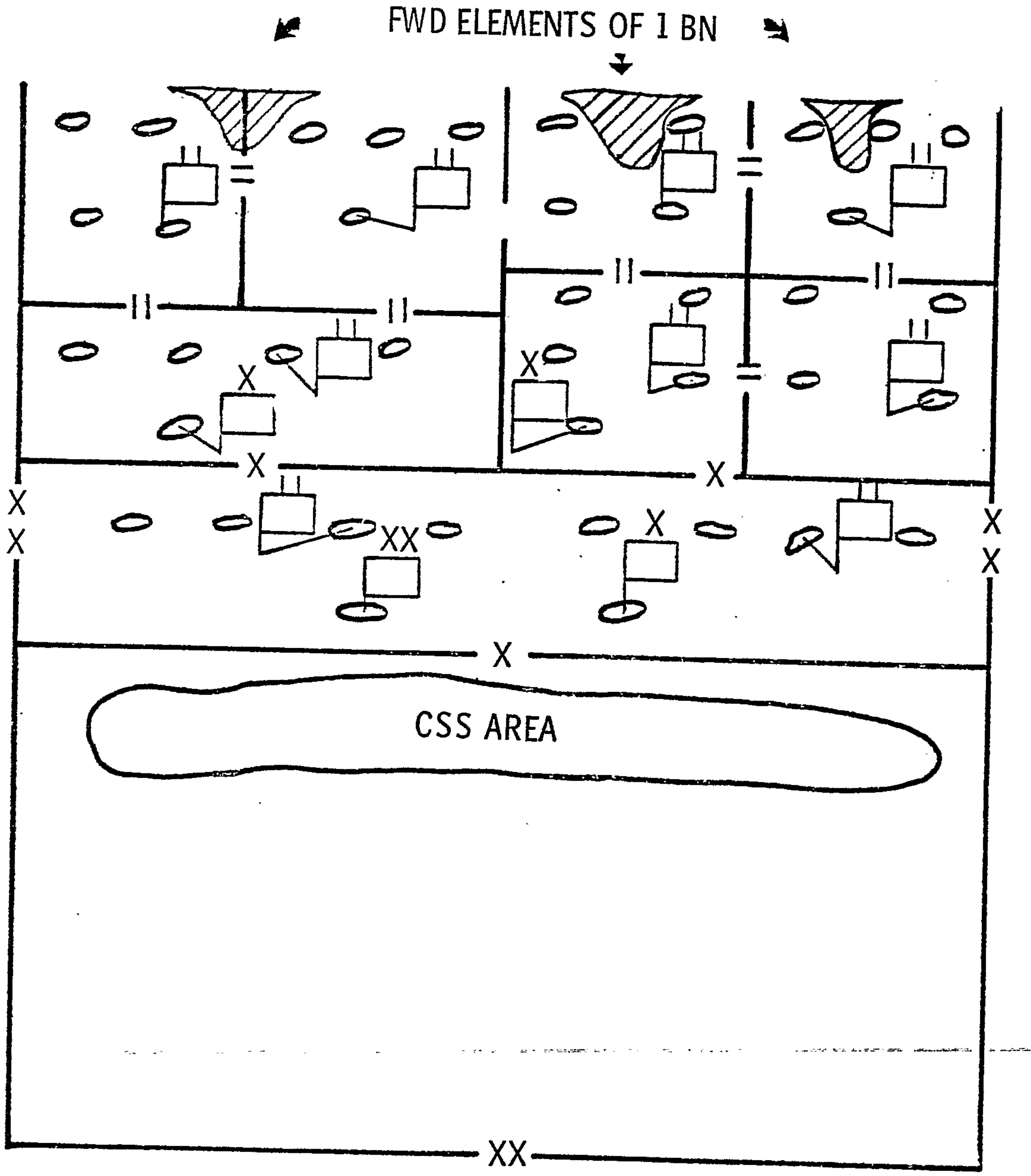

FWD ELEMENTS OF 1 BN
II
II
II
II
X
X
X
X
X
XX
XX
XX
XX
CSS AREA

Figure 6

Perhaps the most radical departure from established defensive doctrine is a concept identified as the dynamic defense (see Figure 7). It is a form of mobile defense with units widely dispersed both laterally and in depth.

The battlefield is characterized by a high degree of elasticity in which small units will freely maneuver depending on enemy pressure—but they will maintain contact and will not voluntarily relinquish previously occupied positions. Accepted is the fact that forward units are vulnerable to temporary isolation from other units. In this concept, it is expected that friendly and enemy forces will be greatly intermingled, thus limiting the size of nuclear weapons employed by both sides. Uncommitted units may be deployed to contain one or more enemy penetrations as depicted, or massed-to counterattack if warranted by the tactical situation.

Offensively, two diametrically opposed concepts are to be examined. The first is one in which the employment of nuclear weapons dictates the scheme of maneuver considerations. A nuclear fire plan is developed to destroy the maximum number of acquired targets, and the force is maneuvered to exploit the results of the destructive power of the nuclear fires. This concept embraces increased nuclear preparatory fires with a concomitant decrease in use of on-call fires. At the other end of the spectrum is a tactical concept which incorporates nuclear fires exclusively to support a scheme of maneuver. The commander will pursue a maneuver plan which he feels offers the greatest degree of success and employs nuclear weapons to support that plan. As the attacking force develops new targets, on-call fires are employed; fewer preparatory fires are employed. This second concept is essentially the same as current doctrine.

Within these three defensive and two offensive alternatives we are investigating the utility of company versus battalion sized granules. "Granule" is a term which comes from the Frontier Shield Troop Test and is defined as a tactical unit capable of operating independently for extended periods of time while separated from its parent unit. Actually, it is nothing more than a cross-reinforced company or battalion level unit.

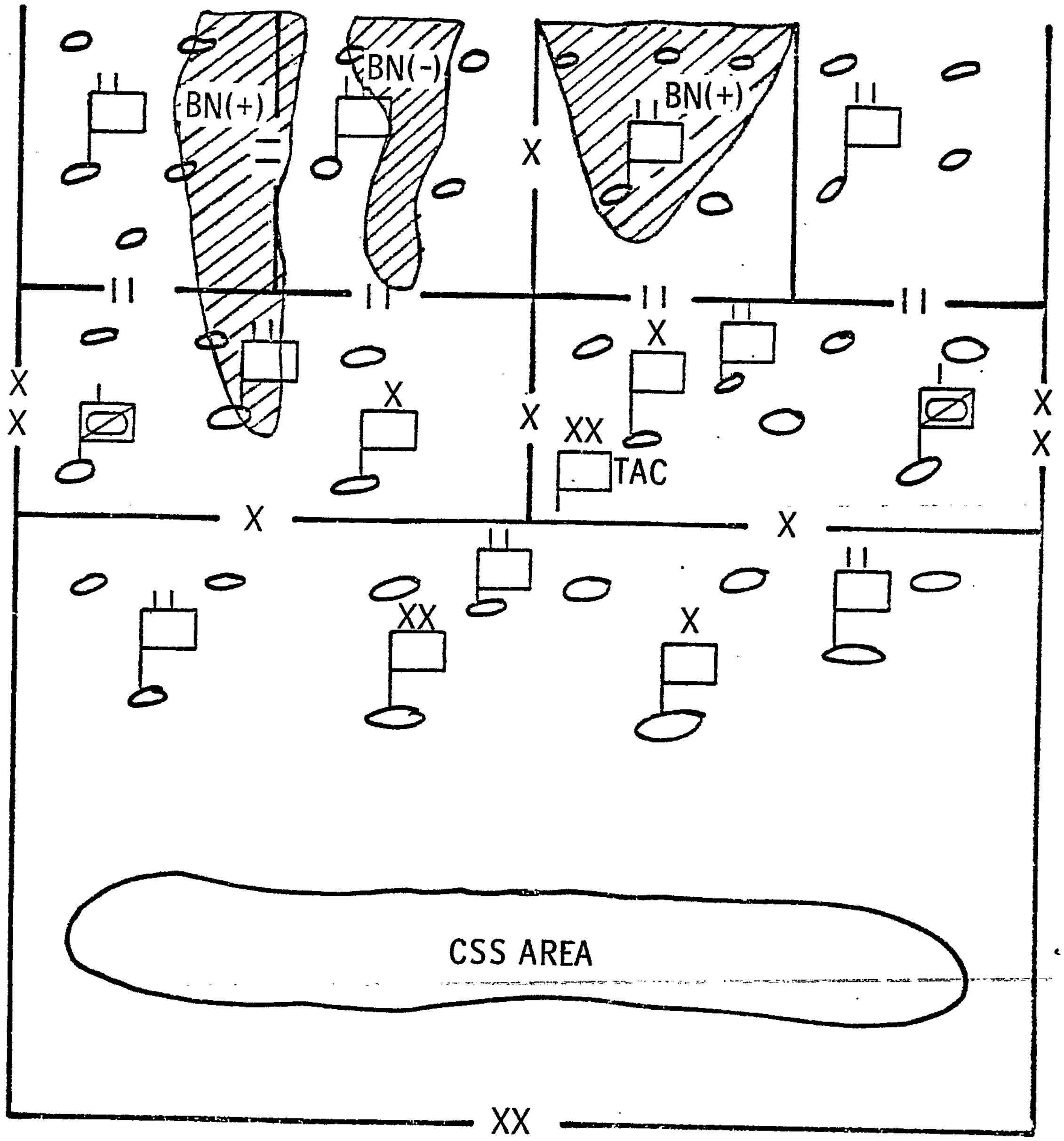
Using the company and battalion sized granules, we are trying to define the geometry of the battlefield. We are attempting to discern the most protective disposition that still retains enough employable combat power to accomplish its mission.

Combat Operations

A. Frontages and Depths.

The company is the lowest maneuver unit level for which specific frontages and depths were developed. Under favorable circumstances of terrain and observation it has been previously determined that a company can occupy and defend a position with a front of 1400 meters and a depth of 1000 meters. ICAS has accepted this as a reasonable area for a company to operate on in a nuclear situation. In considering the company frontage it is accepted that a single enemy nuclear weapon detonated over the center of a company position will make that unit combat ineffective.

DYNAMIC DEFENSE WITH PENETRATION


BN(+)
BN(-)
BN(+)
X
II
XX
TAC
CSS AREA
XX

MULTIPLE PENETRATIONS POSSIBLE AND ACCEPTABLE

Figure 7

Appropriate distances between companies were determined in light of assuring employment of a 155 mm nuclear weapon in the gap between companies with a negligible risk to warned/protected personnel. The minimum distance companies can be separated using this criterion is 3600 meters. Another advantage of using the 3600-meter interval is that it minimizes nuclear vulnerability (Figure 8); e.g., a 30-kiloton weapon detonated at the center of the 3600-meter interval would probably affect no more than one platoon in each company. This estimate is based on radii of vulnerability (RV - 30 kt/protected = 2100 meters) which are somewhat greater than actual radii of damage. Using this approach, a battalion with four maneuver companies—two of which are deployed forward—would occupy a position with a 9200-meter front. The battalion together with DS artillery and other support elements would require a minimum depth of 9400 meters if no maneuver space is allowed for in the rear. Considering the combat support type units likely to be in a battalion area, the depth has been increased to 12 kilometers to provide the commander some flexibility in organizing his area. Another consideration in selecting these distances for examination is the criticism directed at the restrictive aspects of the 9 by 5 kilometer battalion area tested in Frontier Shield.

UNIT VULNERABILITY
(30 KT AIRBURST)

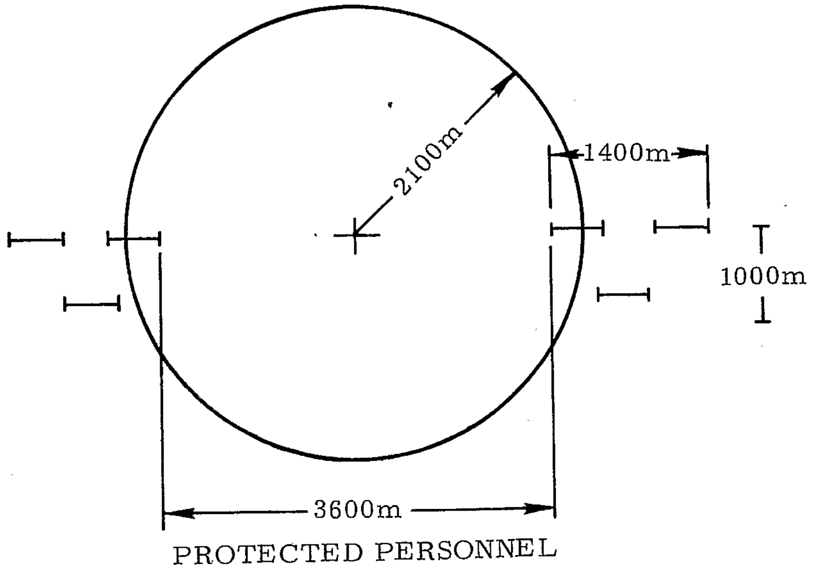


Figure 8

B. Artillery.

Following Oregon Trail and Frontier Shield findings, it was determined that the concept of fragmenting artillery and frequent displacement of units should be further studied. In the NUWAR concept, the battery is the lowest level of dispersion to be considered under normal high intensity conflict circumstances, but the likelihood of single gun employment or even fragmentation into platoons will not be ignored as a possibility. Initial investigations have nevertheless focused on the battery. One factor against the fragmentation of batteries is the fact that in the area of an Army 75 heavy division there are from 9 to 11 tube artillery battalions (including supporting corps artillery), and extensive fragmentation, while attempting to maintain adequate dispersion, greatly complicates space management. It has been suggested that frequent displacement might enhance the survivability of artillery. Accurate survey is the greatest obstacle to such a concept. Two possible solutions to this problem exist. The first involves the use of laser range finding equipment expected to be available in the 1970-75 time frame. The other is employment of the self-contained navigational system in selected aerial vehicles.

C. Logistics.

In the defensive posture, division and brigade logistical elements will be collocated to the rear of the forward brigades in the three forward support areas (FSA's). A fourth forward support area will be formed from elements of the division supply and transport battalion. Supply of food and petroleum products will be accomplished by the unit distribution method from the forward support area to the forward units. Repair parts will be provided by the maintenance battalion, and ammunition will be picked up by the units from the supply points. Maintenance for the forward maneuver units will be accomplished by contact teams.

Emphasis will be placed on maintaining a flow of supplies to the forward units rather than on building stocks in the forward areas. In the division area, aerial resupply will be used as extensively as aircraft availability and the tactical situation will permit, with semiarmored surface vehicles bearing the majority of the movement effort.

Concerning medical operations, the division and battalion elements will be examined to determine whether the widely dispersed maneuver and support units can be satisfactorily supported. The combat support hospital is to be situated near the division rear boundary; and a forward medical company will be in each of the three forward support areas. Self-help must be stressed. Battalion and company medics treat minor wounds, and if the situation permits, casualties will be evacuated out of the division area. The principal MEDEVAC means for seriously wounded is to be the helicopter, while personnel with serious but nonfatal wounds will be stabilized in the forward units, and probably evacuated overland by armored supply vehicles or in equipment being returned to maintenance units to the rear. It is expected that mass casualties sustained in a unit under attack will not be treated—except superficially—until the enemy threat diminishes.

War Gaming

As we examined ways in which this postulated doctrine could be evaluated and further developed, we found that probably the easiest and quickest method would be through the use of a war game. Figure 9 shows some of the key factors which apply to the war gaming activity.

WAR GAMES FACTORS

FORCES

- ★ ARMY--75 HEAVY DIVISION
- ★ SOVIET TANK ARMY

NUCLEAR WEAPONS

- ★ ACTUAL YIELDS AND INVENTORY PROJECTED FOR 1970-1975

RESTRAINTS

- ★ NUCLEAR WEAPONS LIMITED TO MILITARY TARGETS
- ★ MINIMIZING CIVILIAN CASUALTIES
- ★ RESTRICTING WEAPONS YIELDS
- ★ RESTRICTING TYPES OF BURSTS
- ★ AVOID ATTACKING POPULATION CENTERS OVER 25,000
- ★ NUCLEAR WEAPONS PROHIBITED OUTSIDE BATTLE AREA

Figure 9

Combatants for the dynamic play are the Army 75 heavy division as part of a corps in a US field army and elements of a Soviet tank army of 20 regiments. Two Soviet divisions with a total of eight regiments are the immediate antagonists of the US division. Incidentally, the actions of the Soviet Forces in dynamic play are based on actual Soviet doctrine compiled from the latest and most authoritative sources that we could find.

Since the NUWAR Study is aimed at developing doctrine within the limits of organizations and materiel available during the 1970-75 period, projected nuclear weapons inventories for that period, with realistic theater and subordinate unit allocations, are being used. To place the NUWAR effort in the proper perspective, it should be noted that, unfortunately, no commonly accepted definition exists for tactical nuclear warfare. Theoretically, it can range from a minimal one or two weapons a week to an almost unlimited daily expenditure of nuclear weapons in the area forward of the field army rear boundary. Therefore, since we cannot define specifically what tactical nuclear war is or will be, we have chosen to postulate some restraints—drawn from the synthesis of high intensity conflict and designed to keep the warfare within credible tactical parameters. To describe limited nuclear warfare we have assumed that the combatants will practice some degree of arms control and will also refrain from actions that encourage escalation. Limits and restraints are essential if a nuclear war is to be confined to the tactical battlefield. Hence, the course of the war will depend largely on which of the many possible restraints opposing forces observe.

Using the general category of restraints discussed above, specific restraints for the war game were developed, as shown in Figure 10.

WAR GAMES RESTRAINTS

- NUCLEAR ATTACKS ARE LIMITED TO 150 KILOMETERS EACH SIDE OF THE FEBA.
- TARGETS LOCATED BEYOND THE BATTLE AREA WILL BE ATTACKED ONLY BY CONVENTIONAL WEAPONS.
- NUCLEAR STRIKES IN VICINITY OF CITIES (OVER 25,000 PEOPLE) WILL HAVE AT LEAST 90% ASSURANCE THAT NO MORE THAN 10% OF THE POPULACE WILL BE EXPOSED TO AS MUCH AS 50 RAD.
- SURFACE BURSTS WILL NOT BE USED EXCEPT FOR ADM.
- WEAPON YIELDS FOR BOTH COMBATANTS ARE LIMITED TO 50 KILOTON OR LESS.

Figure 10

The rationale for the 150 kilometer factor is that it approximates the size of an area occupied by both the Army 75 corps and Soviet tank army with combat service support for both combatants. (Soviet tank army depth is 100 km: front units supporting army will be in the next 50 km.)

Related to the war games restraints is the assumption that each combatant has certain facilities or resources that it does not want destroyed—or similar facilities belonging to enemy forces which it will not attack. In other words, population centers, industrial areas, or politically significant locations are not likely to be attacked by nuclear weapons unless (1) such action decisively affects the battle, or (2) the areas contain resources vital to both combatants.

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Whether one or both sides will observe any or all restraints and sanctuaries is at best a speculative matter. Assurance that escalation can be prevented is not possible on the basis of military considerations alone. However, the NUWAR Study assumes that geographical restrictions apply and that no strategic exchange of nuclear weapons will occur.

One point to be emphasized is that during war games, if certain tactics or doctrine are unsuccessful and will ultimately lead to the defeat of US forces, the dynamic play will be redirected and alternative solutions sought. The intent here is to avoid wasting time on obviously unworkable concepts and to make maximum use of dynamic play as a medium for developing feasible alternatives.

The war game portion of the NUWAR project has been contracted to the Institute of Combined Arms and Support-Research Organization, a division of Booze-Allen Applied Research, Incorporated. Figure 11 shows the time phasing for the war game activity. The preparatory phase included identification of data sources, development of the data base, and static and sensitivity analysis. As its principal tool, in addition to more than 40 personnel, to conduct the war game, ICAS-RO developed the DIVTAG II model. DIVTAG is an acronym for DIVision Through Army Group. DIVTAG II is a combat simulation model designed to assist in the evaluation of organizational and tactical doctrine for large units. Low, mid, and high intensity warfare can be simulated without model alternation. All doctrine is externally controlled, so there exists no fixed doctrine within the model. Activities of the Navy and Air Force can be played in support of Army activities.

NUWAR WAR GAME

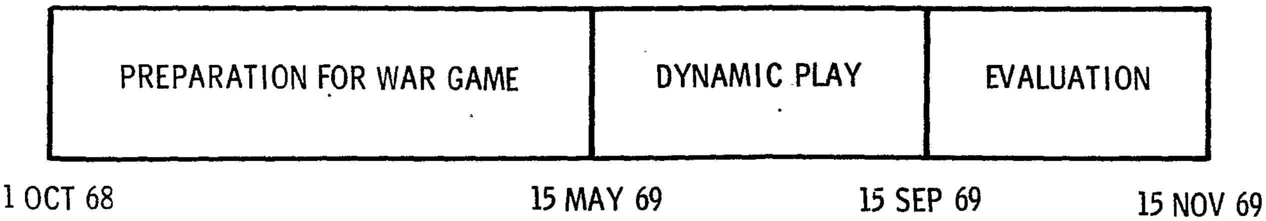

Figure 11

DIVTAG II simulates an extremely broad spectrum of military activity which includes ground operations, air operations, close combat engagements, and special weapon assessments.

DIVTAG II is formally described as a computerized, two-sided, symmetric combat simulation. In application in war games, it can be open, semiopen, or closed. It is basically rigid but can be operated with semirigid intelligence and special weapons assessment. Unit, time, and space resolution can be as small as platoon, centiminute (0.01 minute), and meter. As a maximum, DIVTAG II can play units up to army, length of period (in a single run) up to approximately 7 days, and size of battlefield up to 8000 km square. As many as 1000 units of varying types and sizes can be played discretely in a single game.

Using DIVTAG II and the postulated doctrinal concepts furnished, ICAS-RO is now conducting the defensive phases of the war games. The data produced in each of the offensive and defensive phases will, when analyzed and evaluated, indicate the comparative utility of the several competing alternatives.

The dynamic play of two defensive games has been completed. Analysis and evaluation of the data produced in these games is currently in progress and at the same time, other games are being played. One of the games completed utilized the area type defense with the US forces in company sized granules. The other game employed the mobile defense with battalion sized granules. Both of these games, and those that follow, are fought over the same terrain with both antagonists always starting at the beginning of the war. We are trying to eliminate any generation of comparative data that is due to accidental or artificial game differences. In both games played, the US forces reached predetermined defeat criteria within 3 hours after the start of dynamic play. The Soviet forces reached the predetermined defeat criteria almost simultaneously with the US forces in the company granule-area defense. While not quite reaching defeat criteria in the battalion granule-mobile defense game, the Soviet forces were incapable of continuing their mission without substantial reinforcement. These facts must be tempered with the realization that the defeat criteria are artificial game criteria and that we have not completed our evaluation as to why events occurred as they did. In both games the Soviet forces fired about 85 nuclear weapons while the US forces fired about 55 weapons. A consistent aspect of both games was that dispersion did not prevent targeting. Most targets acquired by both sides were company sized. Once acquired, these company targets were rapidly attacked with nuclear weapons by both sides.

The findings of the war game will be further evaluated as previously indicated in Troop Test Frontier Shield II. This troop test is tentatively scheduled for January 1971 in Europe. The tentative concept of test calls for the use of an Army 75 brigade with its slice of division and corps support and opposed by appropriate enemy units. The friendly force will conduct defensive operations for four days, and offensive operations for one day.

Summary

In summary, the NUWAR study will lead us to an answer to the question, "How do you fight and win a tactical nuclear battle?"

Gentlemen, this concludes the briefing. Are there any questions?

Question and Answer Period

GARWIN (IBM): As I understand it, it's the Soviet doctrine to use a chemical agent in conjunction with their nuclear weapons. Is this taken into account in your war games and in your troop tests?

KNOX: No, we are not going to play chemical agents in either the war game or the troop test. We have considered it in the doctrine but we are not going to play it. We are attempting to keep the program within manageable limits.

GARWIN: So far as I remember it, Dr. Ord yesterday said that in some of the Soviet exercises about equal numbers of FROG's with chemical warheads and with nuclear warheads were employed. It seems to me that this doesn't model the situation properly if one neglects the chemical agent.

KNOX: I believe in recent years the proportion of nuclear weapons has gone up in their exercise. I am not sure about that point. However, I do know you can prepare for chemical operations with equipment rather than with new tactical doctrine. I don't believe it would invalidate our findings to concentrate on the nuclear aspects without, at this time, considering the chemical aspects.

DOUGHERTY (SLA): What kill criterion do you use? In your game or exercises, do you check the sensitivity of the assumptions, for example, what's killing people?

KNOX: Most of the casualties in these first two games have been from the effects of nuclear weapons.

DOUGHERTY: What rad level, for instance, do you use as kill or incapacitation?

KNOX: The generally accepted 650, plus or minus 150 rad, is the kill criterion—LD50. Neither this information or any other information available was precise enough for war games. So we assigned killing doses of radiation going all the way up to 3000 rad exposure. For instance, someone getting a 3000 rad exposure was expected to be of no more use to the forces involved from that instant on. Those with lesser amounts of radiation were not expected to be of any use in a few hours. We have documented the assigned radiation levels that we used to put people in an ineffective category, but we are not claiming that we reflect objective truth since there are no figures to reflect this truth.

McDONALD (LRL): You said that Oregon Trail was not accepted because from a paper study it was apparent that the equipment to carry out this deployment was not available in the '68 to '72 time scale, and also apparently there was serious concern about command and control aspects. I gather your field test of this more or less proved this point in the '66-'67 operation that you spoke about. What would you say is the most significant change that your new study projects for that system over the things that the Oregon Trail study itself proposed? Is it just that you are now looking at '75 technology?

KNOX: We are looking at '75 technology. We are attempting to make sure that all the material we use is actually in being, or we have some strong reason to expect it to be in being. For instance, we are not using any nuclear weapons that have not reached at least Phase III. I suppose this is one of the biggest differences in the study. We are trying to get a reasonable balance between being able to fight in a nuclear configuration and maintaining a large, or acceptable, conventional capability for each individual unit.

McDONALD: I would suggest that if you are using only weapons that have already reached Phase III and you are looking in the '75 time frame, you may be denying yourself weapons that are under very active study at this time, and this may not give you the right kind of answers. It certainly won't assist you in trying to find out what weapons you'd like to see developed in that sort of time frame. That might bias the study in a rather unfortunate way.

KNOX: We recognize this problem, but we gave more weight to the possibility of having our study appear to turn on the appearance of new weapons. We hope that we are going to create doctrine that is not so dependent on an individual weapon that comes up in the future.

McDONALD: Let me ask you a specific question about a new weapon system. I know Oregon Trail was quite dependent on the AD-70 concept, or I guess we call it SAM-D now and will call it something different next year. Is there some such air defense field army error and short range missile defense system postulated in your study or not?

KNOX: Not SAM-D.

KING (AFXPD): On what premise do you employ nuclear weapons as a people killer? I am curious as to why you would fire a nuclear weapon. What causes you to fire it?

KNOX: We came up with some criteria for the gamers based on threat to the units they are playing, that they are representing. Essentially, a company (or larger) element immediately opposing some American element, is worth a nuclear weapon. Then we put some restraints into the gamers' instructions—they are not to deliberately over-kill; there are prohibitions against area fire, and we try to make them use it reasonably.

KING: Are you using improved fragmentation?

KNOX: Yes sir, we are—conventional improved fragmentation.

SQUIRE (LRL): One surprise of Oregon Trail is the apparent requirement for some 30,000 or so nuclear weapons. I wonder if you would extrapolate the level of the battle that you were talking about in NUWAR to, say, NATO—what does the quantitative requirement in nuclear weapons turn out to be?

KNOX: So far we have not addressed the problem of making this a requirement study. We are trying to keep it in a doctrinal area. We have attempted to use, as the inventory available to the Air Forces in both areas, what we believe may become available in the time frame. But as far as requirements are concerned, this study really doesn't address that problem in the best manner; it wasn't intended to. We are going to investigate what would happen if the US force had 25 percent—or 50 percent—as many weapons as it does. But this study is really not a requirement study.

LAUREYNS (General Dynamics): What was the principal means of gaining intelligence for the use of your nuclear weapons, and are the results very sensitive to that means of locating and identifying units to be attacked?

KNOX: All the sensor elements that are available to the division, either organic or at services, are played in the game, including Air Force RECCE, Army Aviation, acoustical devices, seismic devices, patrols, and, listening post radar. We have attempted, at great length, to get accurate factors for their capabilities ground into the machine, and I believe we have, after several false starts.

LAUREYNS: You couldn't identify certain of those elements as being the most frequently used or most effective?

KNOX: In the early stages there was a four-hour period when the opposing force, the Soviet force, was across the border and moving toward our FEBA. During that period, the Air Force RECCE was most effective. After that period, which stopped at about 1200 or 1130 in the morning, the ground combat started around noon; after that time, I don't know just who got the most targets.

Colonel James M. Page
USA, USAREUR

TACTICAL NUCLEAR WARFARE 1972 - 1978

The nuclear capability of US Army Forces, Europe, has grown from a single gun battalion, first introduced in June 1953, to the present capability, which ranges in size from the 155 mm howitzer, with a range of about 14 km, to the Pershing missile with a maximum range of approximately 740 km.

As our capability has increased, we have also seen the capability of the Warsaw Pact forces increase, and today we have nuclear giants facing each other in Europe, both sides having a capability to engage in strategic and tactical nuclear warfare.

The purpose of this briefing is to familiarize you with USAREUR's concepts and weapons requirements to fight a tactical nuclear war. A USAREUR study on tactical nuclear weapons requirements, Central Europe 1972-1978, was completed in October of last year. The study had a twofold purpose: (1) to postulate USAREUR's concepts and requirements, and (2) to stimulate discussion about these concepts between and among the national forces comprised in the Central Army Group, Europe. The study was forwarded to selected NATO and US Headquarters for review and consideration in the computation of nuclear weapons requirements for Central Europe. The information presented today represents approved USAREUR concepts, and at the present time stated requirements remain under consideration at various higher headquarters.

You will notice that this study concentrates upon the requirements and justification for ground tactical weapons, because they are our business. We recognize the essential nature of Air Force requirements and do not intend, by our study, to reflect otherwise.

The briefing will cover the following aspects of tactical nuclear war:

1. Concept
2. Threat
3. Weapon requirement

CINCUSAREUR's tactical nuclear concepts are:

1. Avoiding strategic exchange
2. Battle area deployment
3. Phases of operation
    - Stabilization
    - Nuclear dominance
    - Exploitation

Tactical nuclear weapons as a deterrent are only as effective as our ability and willingness to employ them, coupled with the enemy's knowledge of our willingness.

The requirement to utilize tactical nuclear weapons in Central Europe could arise in any of several ways. It could arise as a result of conventional attack and escalate to a tactical nuclear war, or it could be caused by a surprise nuclear attack. In any case the basic requirement would probably arise from a miscalculation on the part of the Warsaw Pact. If a conventional attack were made against Central Europe by the Warsaw Pact, the Warsaw Pact authorities must have considered that there was a good chance that NATO would either risk defeat and not use nuclear weapons at all, or would not use them either in time or in such a way as to prevent the Warsaw Pact from attaining its objectives. On this basis, the inference would be that either the Warsaw Pact had a reason to doubt NATO's will to go nuclear; or had set itself a geographically limited objective capable of early attainment; or had launched an aggression whose scope could be modified according to NATO's response.

It is not NATO's desire to initiate a nuclear war; however, the choice may be forced upon us as a matter of survival. We must, at that time, be prepared to use our weapons.

In the event a nuclear war starts, it is reasonable to believe that both the United States and the Soviets will try to avoid a strategic nuclear exchange, because of the mutual devastation and casualties that would be inflicted. Consequently, in a NATO-Warsaw Pact confrontation the employment of nuclear weapons would probably be restricted to the battle area, or would be restricted by other mutually advantageous constraints. Both NATO and the Warsaw Pact possess the forces and the tactical nuclear weapons to mount such a war. Therefore, a tactical nuclear war is expressed as a realistic option that may occur on the European continent.

In conjunction with this, is the concept of the initial employment of nuclear weapons. The initial employment would certainly demonstrate our willingness to use our weapons, and the strike, if used with precision, could well cause the enemy to reconsider, halt his aggression, and retire behind his borders.

The initial weapons employment could be limited to a small strip of territory on the eastern border of the Federal Republic and the western border of the Pact, to minimize civilian casualties. This border strip is thinly populated, so the effects on the population would be minimized. The longer the release of weapons is delayed, the farther the enemy will advance and the greater will be the likelihood of increasing the number of friendly civilian casualties (see Figure 1).

The first option to be employed could be atomic demolition munitions utilized to enhance natural barriers and create obstacles to enemy movement. These weapons are essentially defensive in nature, noncasualty producing, and if buried would produce relatively little fallout. ADM employment, coupled with appropriate warning to the Warsaw Pact, would certainly provide unmistakable evidence of NATO intentions, while restricting effect to NATO territory.

In the event the Warsaw Pact forces breached the barrier and continued to advance, then the next step would be a simultaneous attack with small yield tactical nuclear weapons employed across the central front (see Figure 2).

This selected nuclear response must provide for employment of sufficient weapons to render an enemy incapable of immediately continuing the attack. Small yield weapons, airburst, with small delivery errors would be used, both for precision and to minimize civilian casualties. The weapons should be delivered as nearly simultaneously as possible along the entire central front. The numbers of weapons and the simultaneous strike are both necessary: (1) to illustrate to the aggressor the penalty of his aggression; (2) to illustrate that no part of the battlefield is a sanctuary, and (3) to demonstrate NATO's unity of purpose in defense of NATO territory. Counterattacks in conjunction with this nuclear strike would be characterized by short, sharp, small unit actions.

This initial blow should face the enemy with the extremely difficult problem of what to do next—quit the attack, respond in kind, or escalate. If he responds in kind or escalates, we then need a concept to fight this escalated but still limited war. This expanded tactical nuclear conflict has been called a "sanctuary" war by some; a sanctuary because neither the US nor Soviet homelands would be struck. Our concept to fight the expanded or theater nuclear war—which is still localized—is identified in three phases:

Phase I. Stabilization -- The initial phase would be characterized by NATO ground elements seeking out and destroying, as first priority, the Warsaw Pact nuclear delivery means. Friendly ground forces would be assisted, where possible, by air elements that could be diverted from the air battle. The second priority efforts would be the destruction of his maneuver units and control elements. NATO units, particularly nuclear delivery units, would move frequently, under cover of darkness, in order not to be targeted and destroyed. Command and control would be tenuous at best because communication would be disrupted by electromagnetic effects. Logistical support would be disrupted. In the tactical units, survivability would be paramount, and would be in direct ratio to the state of training of the unit and the caliber of leadership at the middle and lower levels. During this period,

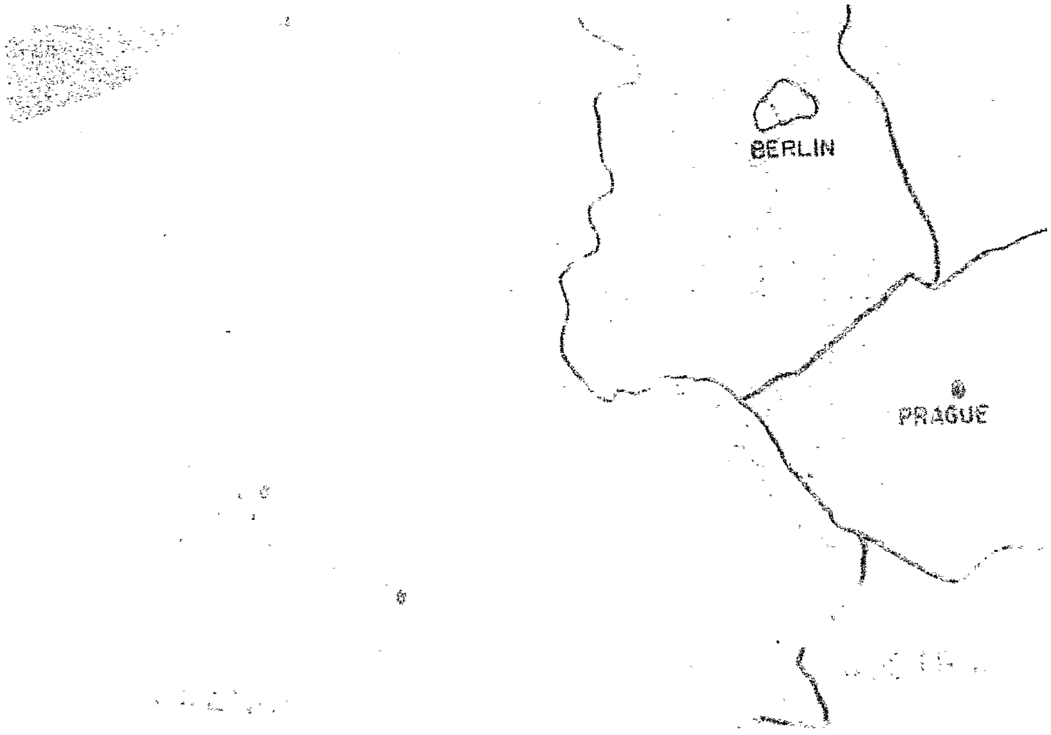
BERLIN
PRAGUE

Figure 1

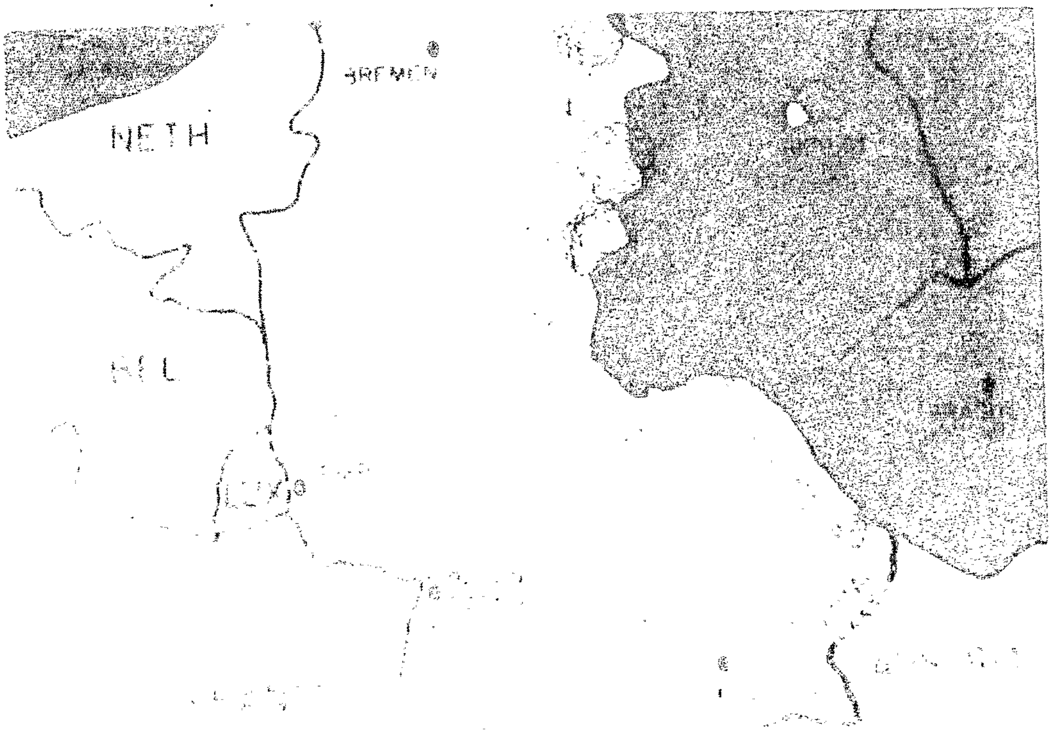
BREMEN
NETH
BEL
LUX

Figure 2

the bulk of the friendly air effort would be directed to winning the air battle. At the end of Phase I, USAREUR anticipates a force disposition characterized by small maneuver units and scattered nuclear delivery means.

Phase II. Nuclear Dominance -- The aim of surviving fighting units must be completion of the destruction of the Warsaw Pact nuclear delivery means. At the same time, the capability to recover and reform maneuver elements and residual nuclear delivery capabilities must be maintained. Nuclear supremacy can be achieved by a combination of actions:

1. Destroying or causing the enemy to exhaust his supply of nuclear warheads.
2. Destroying the enemy's delivery vehicles.
3. Rendering his launcher crews and assembly teams casualties. During this period, surviving NATO combat elements would consolidate into battalion size formations. Disrupted command and control would be re-established and nuclear delivery fire units incorporated into these task forces so that residual nuclear weapons would be available to support the next phase.

Maintaining contact with surviving air elements would be critical to continued air support and target acquisition operations.

Logistic support would be re-established by:

1. Locating surviving supply dumps and indigenous resources.
2. Initiating recovery operations to place serviceable equipment back into operation.
3. Aerial resupply.

Phase III. Exploitation -- NATO forces at this point would conduct comparatively small scale military operations against a weakened, disorganized, and demoralized enemy. The NATO task forces would continue the process of reconstituting units, probably as national groupings. Thus, combat forces responsive to a command and control organization would continue to grow and would ultimately destroy or eject surviving Warsaw Pact forces remaining on NATO territory.

After determining the concept of phasing the war, it becomes necessary to examine the threat (see Figure 3). The Soviet ground forces will remain the largest element of the Soviet establishment. Their availability supports the concept of large numbers of divisions advancing rapidly along the avenues of approach through NATO defenses in the aftermath of a nuclear exchange. Virtually all of their divisions are either tank or motorized rifle divisions. They have been streamlined, and with nuclear fire support, are designed conceptually to advance as rapidly as 100 km per day. Their equipment is rugged, simple, and standardized, and should continue to function for long periods of time without breakdown. The logistical system is designed to support this rate of advance. Any POL problems would be largely solved if the Soviets acquired even a small part of the POL stored in the Federal Republic of Germany near the Warsaw Pact border. The Warsaw Pact would mount a combat ready force of 79 divisions, 61 immediately available, and 18 more within six days.

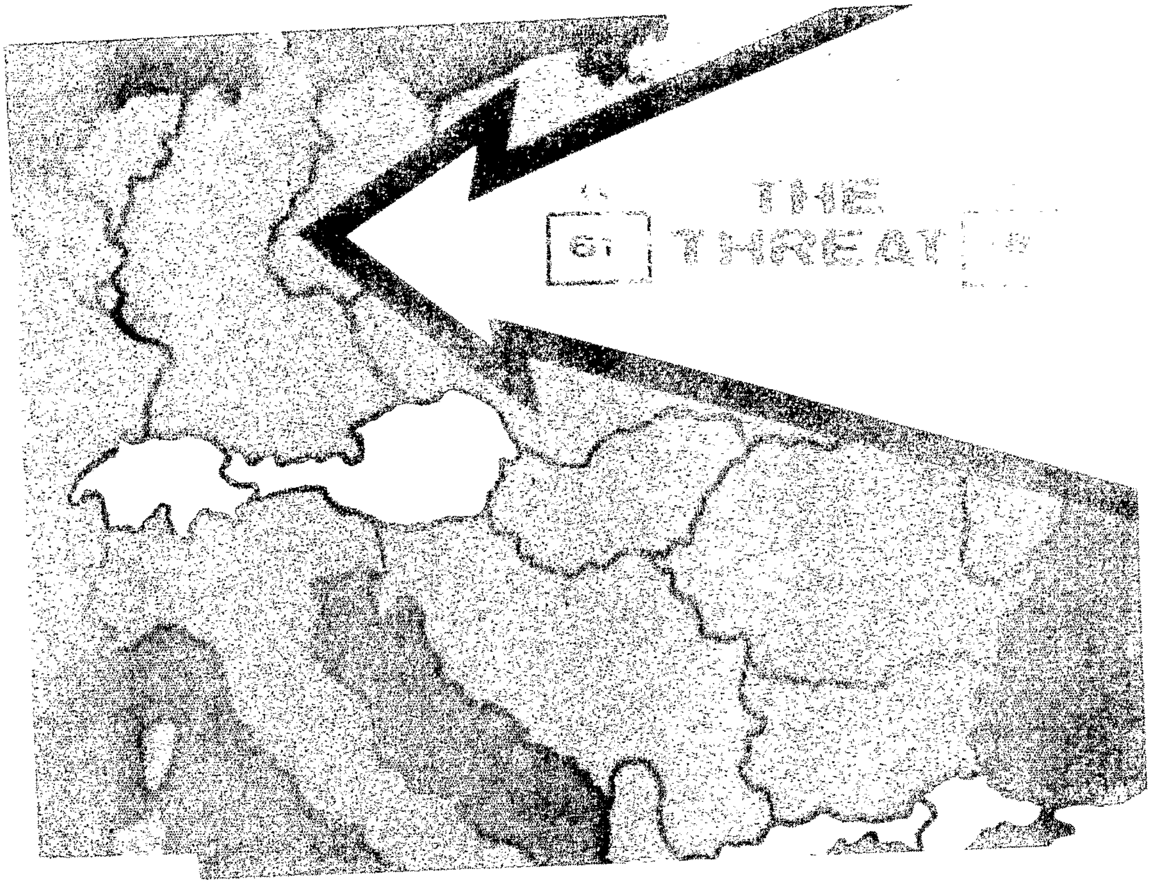

Figure 3

This force is supported by tactical nuclear delivery systems. Soviet tactical nuclear delivery systems will consist of the free rocket over ground or FROG, which is organic to Warsaw Pact divisions, a follow-on or SCUD guided missile with capabilities similar to NATO's Pershing, and a longer range SS-12 guided missile in support of the front organization (see Figure 4). Current launcher estimates show 237 - 316 FROG's and 190 SCUD's and SS-12's available to support the force. Approximately 3800 tactical aircraft would be available, and 580 of these would be light bomber or RECCE aircraft (see Figure 5).

For comparison purposes, the approximate number of ground delivery systems in Central Europe for both NATO and Warsaw Pact forces are shown on Figure 6. The weapons are categorized as cannon artillery, rockets, and short range ballistic missiles. As you can see, at this time we have an absolute advantage in cannon artillery. In order to make the delivery comparison more meaningful, the medium range ballistic capabilities of both forces are shown. You will note that in this field the Soviets have an absolute advantage vis-à-vis NATO.

A study was made of this threat to develop the target array within a division slice of the combined arms army.

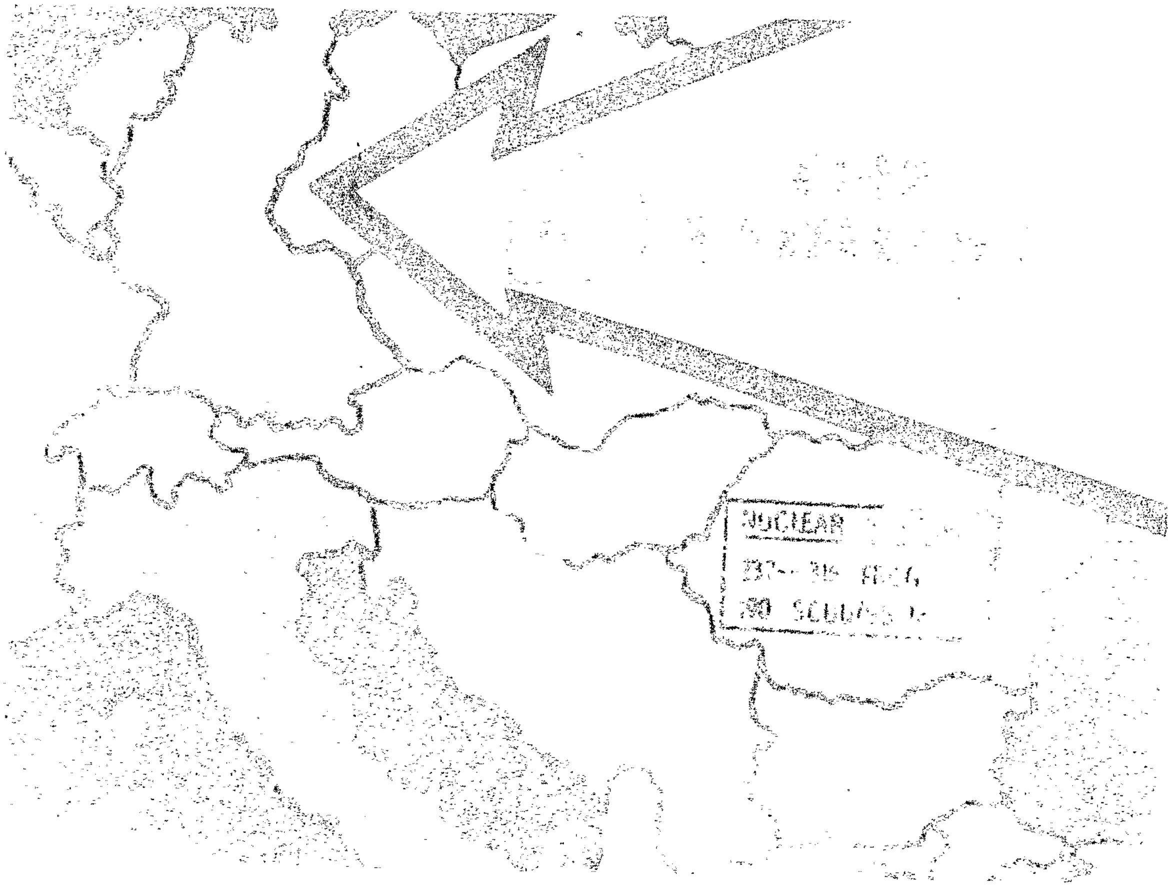

Figure 4

Both fixed and mobile targets will be attacked by NATO forces in a nuclear war in the Central Europe region. Typical fixed targets are airfields, rail centers, communications centers, critical road intersections, bridges, supply installations, and nuclear weapons storage sites. Weapons for these fixed targets are in SACEUR's nuclear strike plan and were not considered in our study of requirements for a tactical nuclear war. Mobile targets are normally tactical force locations that move at random periods of time, and they are addressed.

Fixed targets are described in three dimensions—map coordinates and altitude; mobile targets, in four dimensions—map coordinates, altitude and the time the target is at these coordinates. Rarely can the fourth dimension be accurately forecast, so an estimated time must be used. Numerous war games have been conducted to establish a realistic number of mobile targets. Conclusions from these studies indicate that a division slice of targets in a Warsaw Pact front is the best methodology. This division slice of targets includes division maneuver elements, control headquarters, fire support, and logistic facilities, as well as the nuclear delivery units in a combined arms army back to 60 km in the rear of the area's forward edge. These war games have indicated that in an area of 60 km beyond the battle area's forward edge on a division front, there were 79 targets categorized as shown in Figure 7.

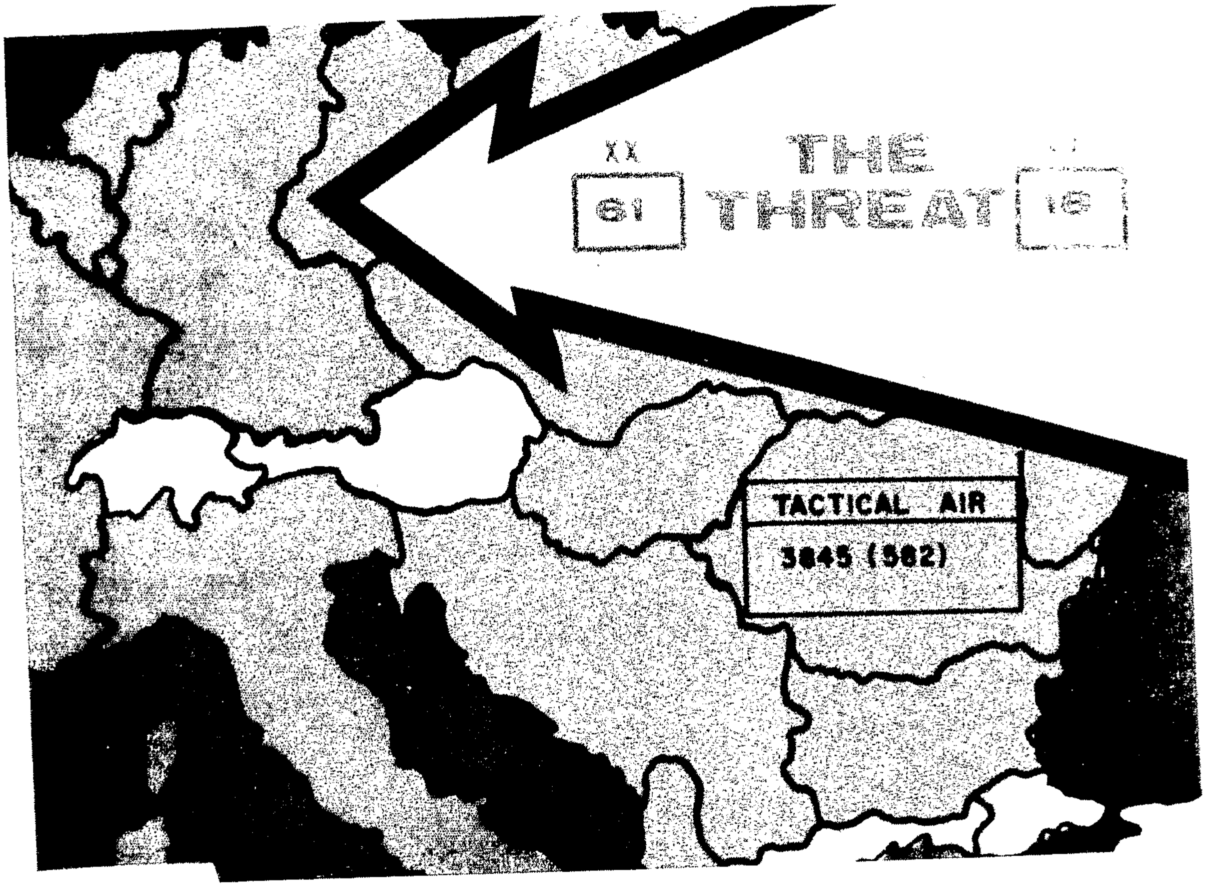

Figure 5

Category I Targets -- Nuclear delivery units, surface-to-air missile units, and their control headquarters. The threat represented by this type of target is serious enough to warrant 90% assurance of 100% destruction.

Figure 8 represents a schematic of a division slice extending from the FEBA to a depth of 60 km into the enemy rear zone. You will note that there are 10 Category I targets located at various distances from the forward edge of the battle area. The distances are measured in kilometers with the 10 targets located in an area between 4 and 60 km. All must be successfully attacked.

Category II Targets -- Aviation, artillery, infantry, and tank units of company size or larger, and regimental size headquarters (see Figure 9). The threat of this category of targets is considered to require a 90% assurance of 50% destruction. There are 60 Category II targets, and at least 50% destruction must be reached here.

Category III Targets -- Engineer, signal, and combat service support units or activities (see Figure 10). These targets do not represent an immediate, direct threat. This threat requires only a 90% assurance of 33% destruction. There are 9 of this category, and 3 must be successfully attacked.

Note that airfields are not listed in the target categories, for as mentioned previously, they are programmed for attack in SACEUR's scheduled program.

I wish to emphasize that we do not program for destruction of every target in the division slice, but rather only the minimum number of targets necessary to insure their defeat. Of the targets to be attacked, you will note that the level of assurance of destruction is commensurate with the threat of the individual target. Our study reveals that 43 of the 79 targets in the Warsaw Pact division slice must be successfully attacked in order to defeat the division (see Figure 11).

COMPARISON OF DELIVERY MEANS

	CANNON ARTY	ROCKETS	SRBM	MRBM
NATO	600 (plus) (155/8")	125 (plus) (HJ)	50 (plus) (SGT/PERSH)	0
WARSAW PACT	0	237-316 (FROG's)	190 (SCUD's-SS-12)	600 (plus)

Figure 6

TARGETS

CATEGORY I - NUCLEAR DELIVERY UNITS, SURFACE-TO-AIR MISSILE UNITS, CONTROL HEADQUARTERS: 90% ASSURANCE OF 100% DESTRUCTION

CATEGORY II - AVIATION, ARTILLERY, INFANTRY AND TANK UNITS (CO AND LARGER). REGT'L SIZE HEADQUARTERS: 90% ASSURANCE OF 50% DESTRUCTION

CATEGORY III- ENGINEER, SIGNAL AND COMBAT SERVICE SUPPORT UNITS: 90% ASSURANCE OF 33% DESTRUCTION

Figure 7

[redacted]

DIVISION SLICE TARGETS

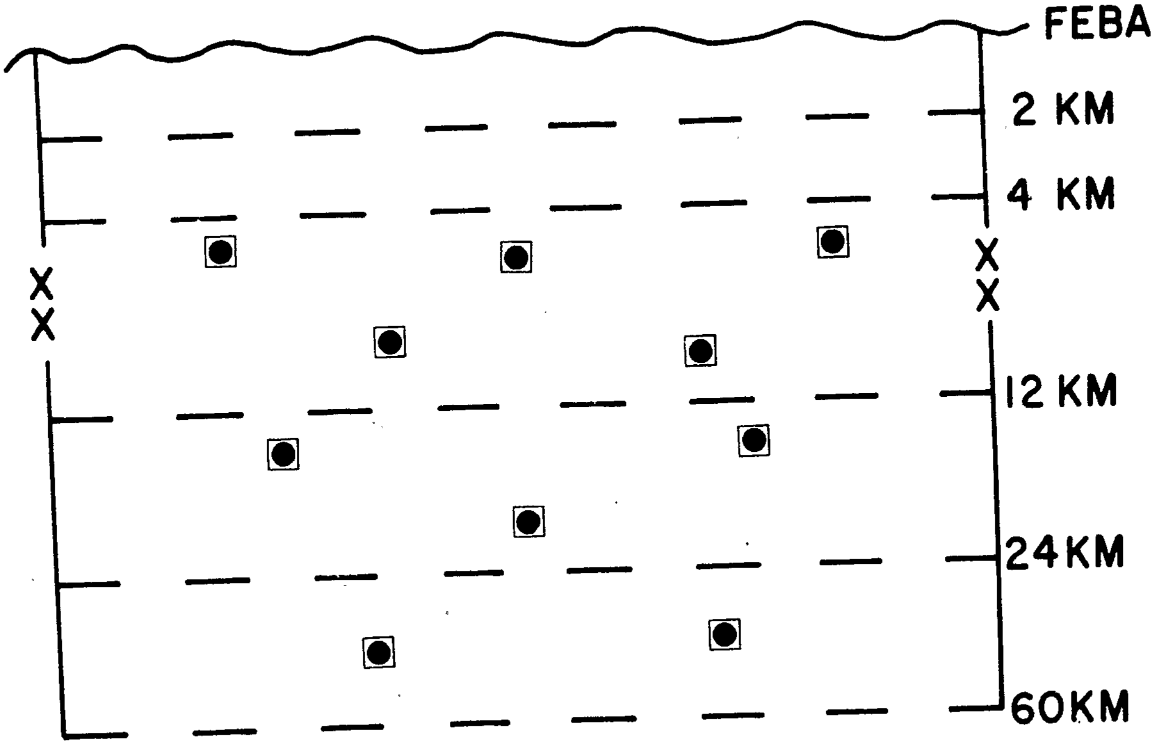
FEBA
2 KM
4 KM
XX
XX
12 KM
24KM
60KM
CAT I ▣

Figure 8

DIVISION SLICE TARGETS

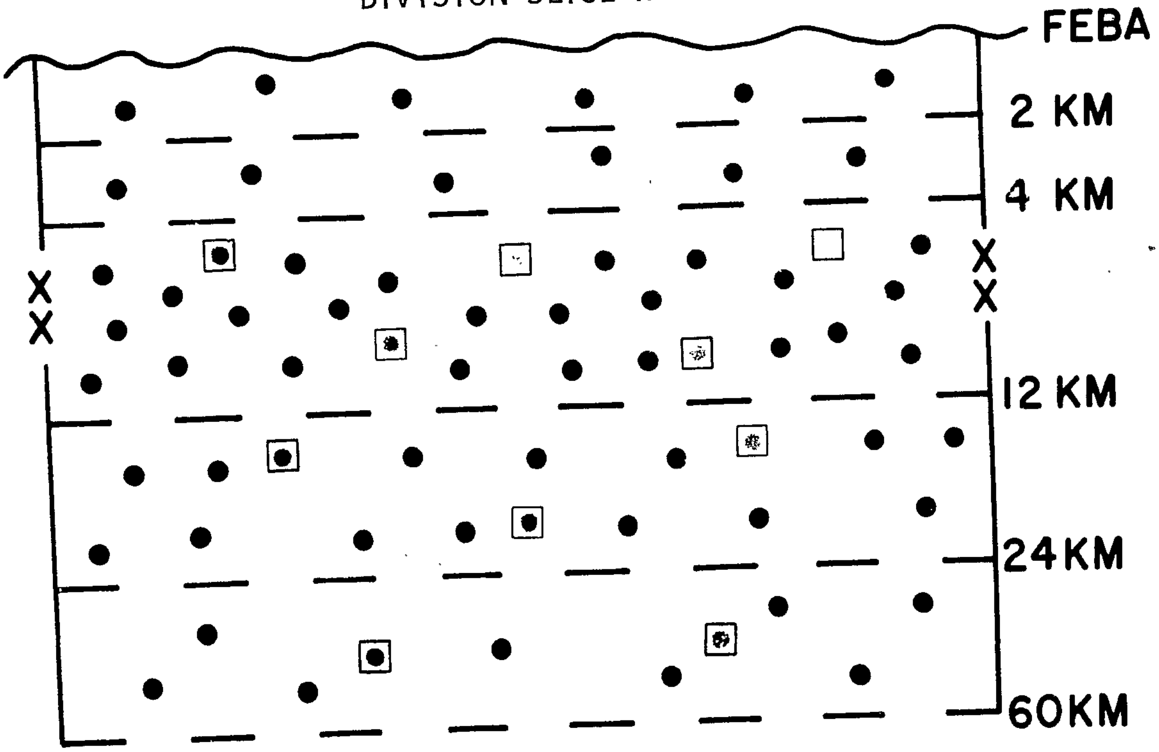
FEBA
2 KM
4 KM
XX
XX
12 KM
24KM
60KM
CAT I ▣
● CAT II

Figure 9

[redacted]

DIVISION SLICE TARGETS

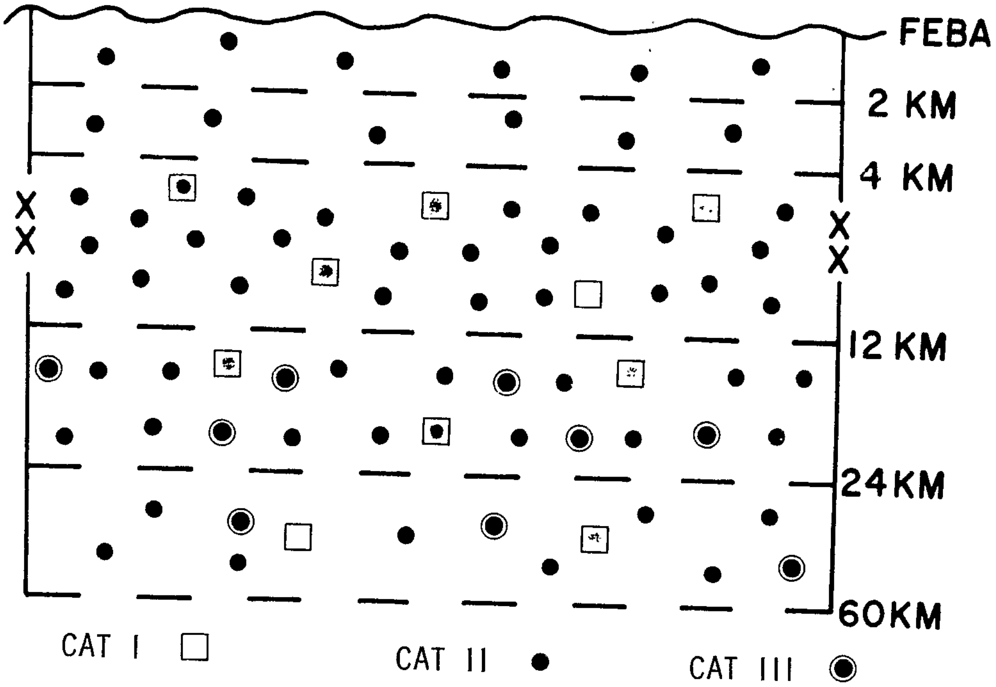
FEBA
2 KM
4 KM
XX
XX
12 KM
24KM
60KM
CAT I □
CAT II ●
CAT III ◉

Figure 10

DIVISION SLICE TARGETS

TOTAL 79 ATTACK 43

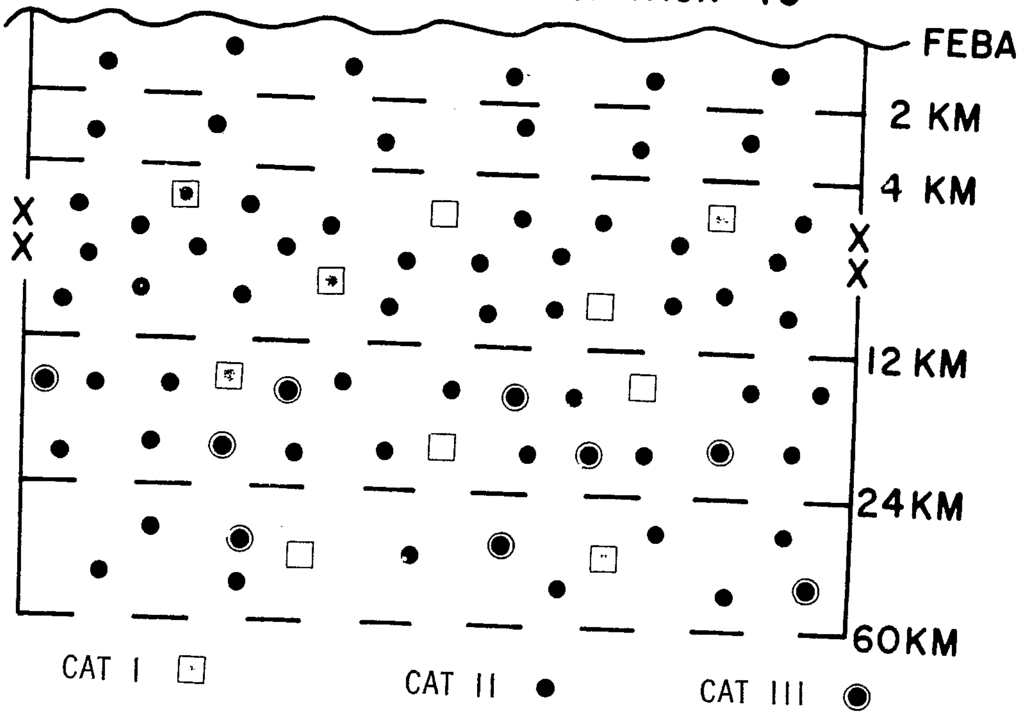
FEBA
2 KM
4 KM
XX
XX
12 KM
24KM
60KM
CAT I □
CAT II ●
CAT III ◉

Figure 11

Based on the distance of the targets from the forward edge of the battle area, and the ranges of our weapons systems, the following weapons will be utilized:

1. The 155 mm howitzer for targets from 0 - 12 km from the FEBA (see Figure 12).
2. The 8 inch howitzer for targets from 2 - 12 km from the FEBA (see Figure 13).
3. The Honest John for targets from 12 - 24 km (see Figure 14).
4. The Sergeant for targets out to 60 km (see Figure 15).
5. The Lance missile system which, although not in current army inventory, is scheduled for introduction into USAREUR in 1972, and was included as one of the weapons systems. It will cover the same range of targets as the Sergeant and Honest John
6. Tactical air (see Figure 16), which will range throughout the battle area.

Operational factors that impact on the types and numbers of weapons required are shown in Figure 17.

Most of these operational factors have been utilized in previous nuclear weapons requirements studies. However, the operational factor of target mobility was utilized for the first time in this weapons requirement study. This factor represents the probability that a target will remain in place from time of discovery until a nuclear strike occurs. After consideration of these factors, it is evident that more than one weapon must be programmed per target to achieve the level of destruction necessary; yet we have presented the worst case to ourselves. We have not programmed weapons for all 79 targets in the division slice, nor have we overkilled those targets that did not require a higher level of destruction.

Figure 18 shows a requirement for approximately 125 nuclear weapons to defeat 43 of the 79 targets in a division slice. Cannon refers to weapons such as the 155 mm and 8 inch howitzer; Rocket, to the Honest John; and SRBM, or short range ballistic missile, to the Sergeant or Lance. Strike RECCE aircraft may be used to restrike targets and to attack mobile targets.

DOE 6.2(a)

DELETED Additional weapons (see Figure 19) must be provided to attack the mobile missile units and other front targets more than 60 km in the rear of the FEBA. The figure 900 represents the approximate total for defeat of all such targets in the central region.

As a result of our study, we find that we need approximately 12,000 weapons to fight a successful tactical nuclear war in Central Europe.

In Figure 20, AD refers to air defense, specifically, the Nike Hercules system, to provide nuclear defense against airborne targets. The number of Air Force weapons required is more than present allocations.

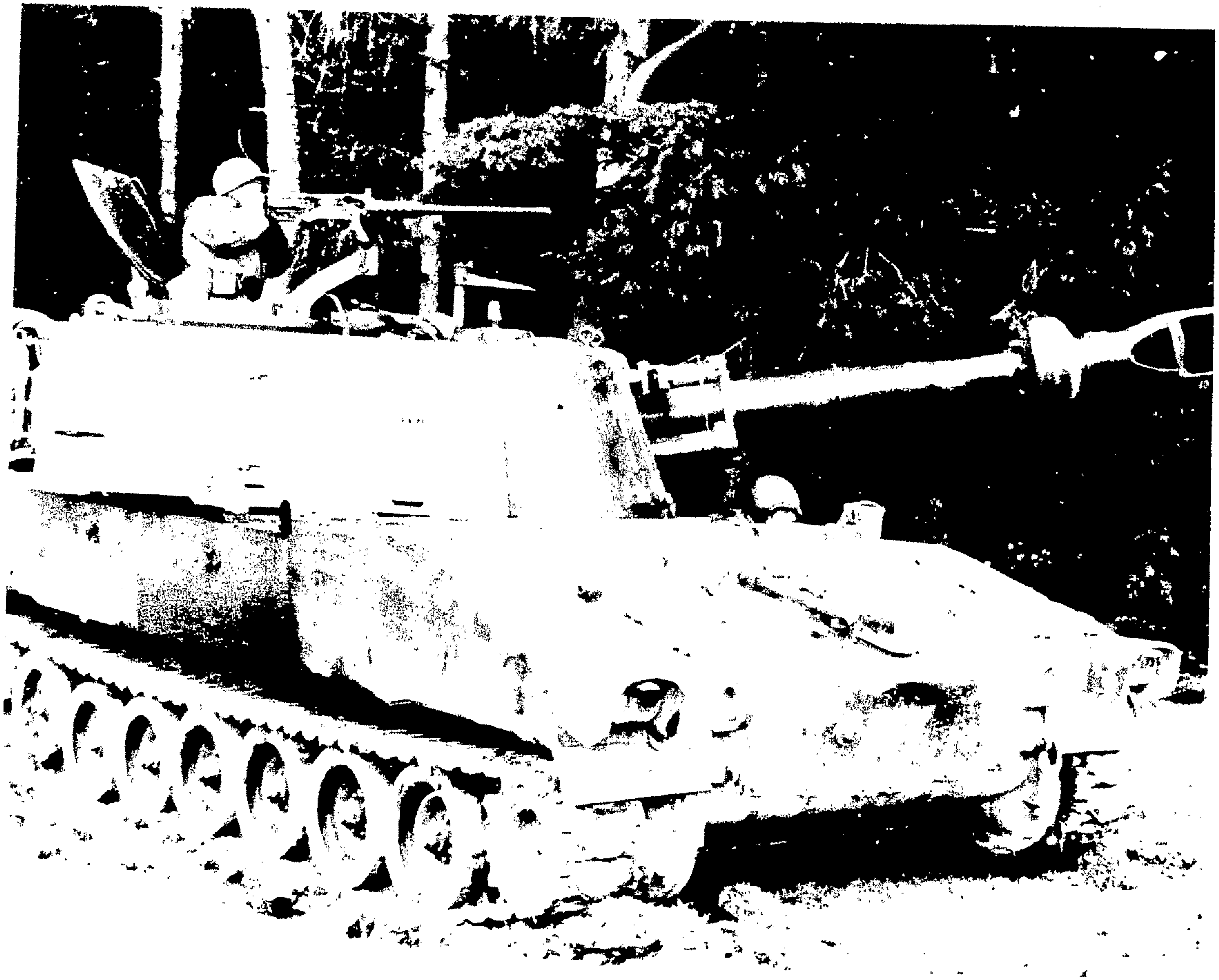

Figure 12

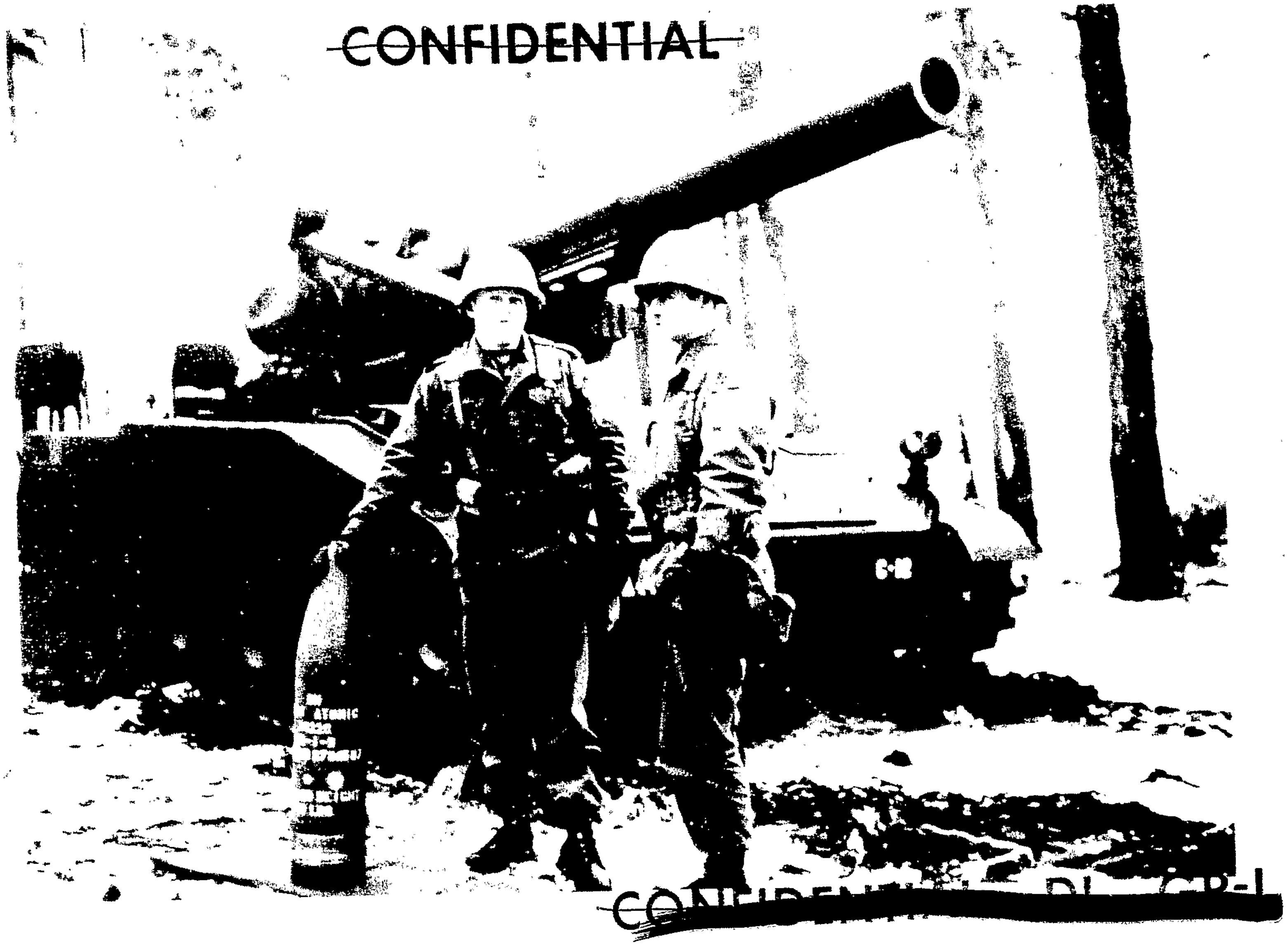

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Figure 13

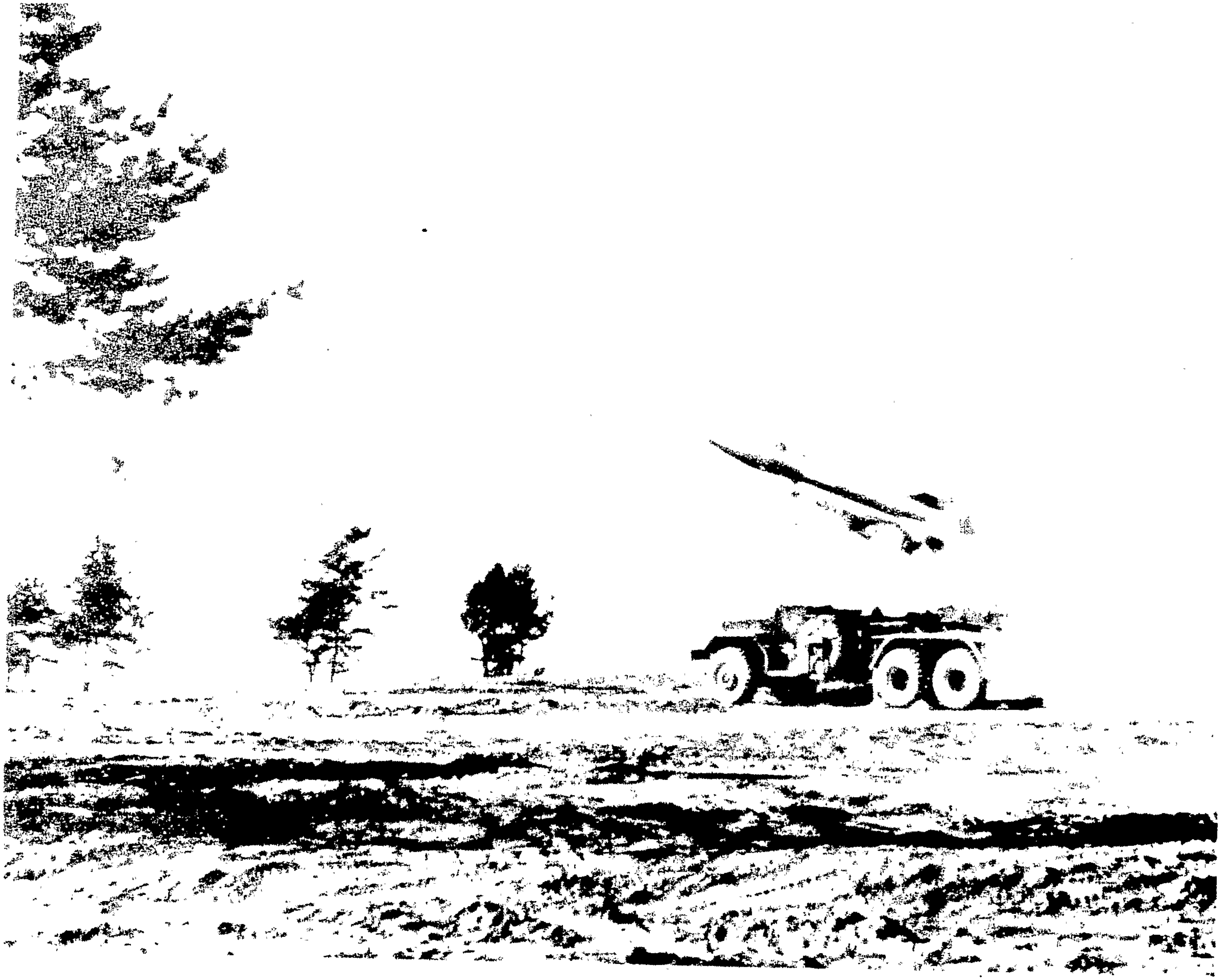

Figure 14

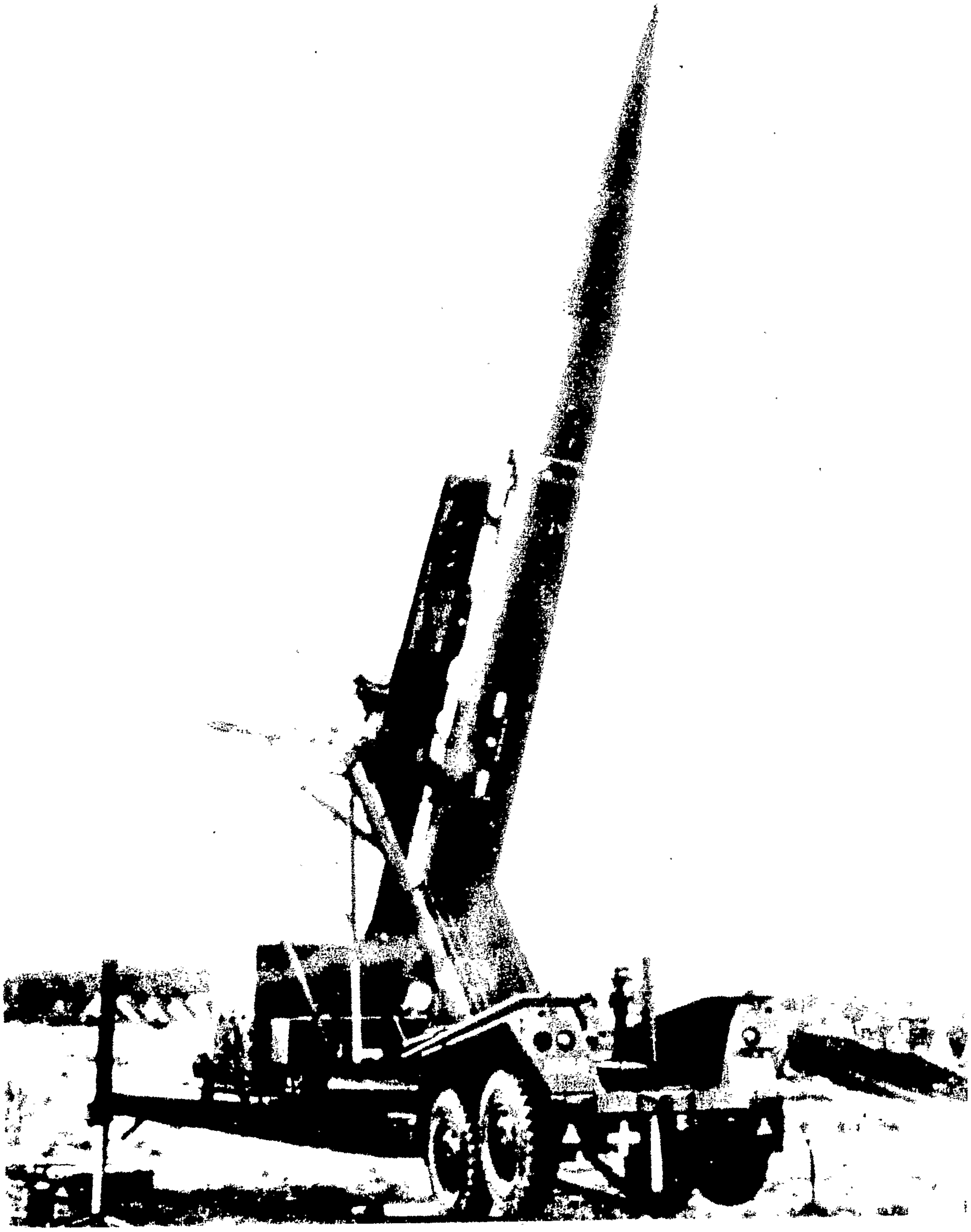

Figure 15

Figure 16

OPERATIONAL FACTORS

- DELIVERY UNIT SURVIVAL
- WEAPON READINESS
- ABILITY TO PENETRATE
- LAUNCH PROBABILITY
- IN FLIGHT RELIABILITY
- ACCURACY OF TARGET LOCATIONS AND TARGET MOBILITY

Figure 17

WEAPONS REQUIREMENTS (APPROX)

WEAPONS SYSTEM	DIVISION SLICE
CANNON	85 (12)*
ROCKET	15
SRBM	5
STRIKE-RECCE	20*
TOTAL	125

*RESTRIKE OF CAT I TO INSURE DESTRUCTION AS REQUIRED.

Figure 18

FRONT TARGETS (APPROX)

WEAPON SYSTEM	TARGETS	WEAPONS
SRBM	150	300
PERSHING	122	330
STRIKE-RECCE	272	270*
	TOTAL	900

*RESTRIKE OF CAT I TO INSURE DESTRUCTION AS REQUIRED.

Figure 19

[redacted]

WEAPONS REQUIREMENTS/ALLOCATIONS

OSD
6.2(a)

DELETED

Figure 20

Considering the threat that opposes us, we feel our study reflects the minimum number of weapons necessary to do the job, and we feel this requirement is an attainable goal.

DELETED

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In postulating our requirements, we studied weapons systems that are not currently in our inventory. Examples are the Lance and the 175 mm nuclear round. It appears that the Lance is a virtual certainty, but we will not receive the 175 mm nuclear round in the foreseeable future. Because of these and other changes, the USAREUR study is being updated this year.

One item of major concern which is recognized by our study, is the imbalance between weapons mix requirements and assets physically on hand. The imbalance is most apparent in cannon artillery and Honest John (see Figure 21).

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WEAPONS MIX IMBALANCE

	STUDY REQUIREMENTS	CURRENT ALLOCATION	DIFFERENCE
CANNON	7000		
HJ	1100		

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Figure 21

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As mentioned earlier, this study was presented to selected NATO Headquarters, and so far it appears that their response has been favorable. They have agreed with the concept and methodology used. Some of CINCENT's comments as they were passed to SACEUR are as follows:

> The AFCENT contribution closely parallels the USAREUR study in several areas, and in particular with the percentage of targets engaged and the factors in computing the numbers of weapons per target.
>
> It is suggested that the nuclear concept of operations should be examined in detail by SHAPE and that future studies consider the concept proposed by USAREUR.

CINCENT is the Commander in Chief, Allied Forces, Central Europe. He commands both the Northern and Central Army Groups. USAREUR and 7th Army are a part of the Central Army Group.

Another of the Headquarters receiving the study was SHAPE, Supreme Headquarters Allied Powers Europe, and it is evident that the USAREUR study had an influence on SHAPE thinking because, in computing their latest weapons requirements, SHAPE, for the first time, used the target mobility factor, as did the USAREUR study.

In summary, we have presented to you USAREUR's concept of fighting and winning a tactical nuclear war, together with a determination of the number of weapons required to support the concept. The successful defense of NATO Europe must include the option of a tactical nuclear war.

Question and Answer Period

CARNE (RAND Corp.): The previous speaker, and you also, commented on the importance of command and control. You were going to use a responsive command and control system to tie all this together. The question is, how are you planning to do it?

PAGE: This could develop into quite a discussion. I assume you would be interested in the step-by-step sequence as well as the overall command and control.

CARNE: For this discussion, concentrate on the question of what basic means of survivable command and control you are going to have. I assume you are going to keep all this under control, tie in the various scattered elements and so on, at a very high level of nuclear violence.

PAGE: This is going to be quite difficult because of the problems that we might run into in using radio equipment, which is what we are heavily dependent upon at this time. I don't have an answer for a very high level command and control. We anticipate that the shorter range radio communication will not be knocked out for a considerable period of time. Long range systems may be.

CARNE: Could you make any assumptions regarding the availability of mallard or tactical concept?

PAGE: Not in this study. I might point out that in this year's study command and control, target acquisition, and atomic demolitions will be addressed much more deeply than they were in last year's study.

FOWLER (DDR&E): Referring to the previous talk, are there some generalizations that one can make concerning the need for a different troop or battle deployment for nuclear war and whether those deployments are more vulnerable to the other kind of war? That is, if you are in a nonnuclear deployment, are you more vulnerable to nuclear attack and vice versa? If so, that must be quite a transition problem both from a communication and a decision point of view. I am wondering if that problem was addressed in either your or the previous speaker's study?

PAGE: I think we all recognize the transition problem and the fact that, if you are fighting a conventional war, your posture on the ground is much more concentrated; the same on the other side. In the conventional posture, the linear distance occupied on the ground is about two-thirds that occupied by a nuclear spread formation. Therefore if you are in a conventional posture when the enemy hits you, you present a much more concentrated lucrative target. This is one reason that we considered a simultaneous strike across the front as one of our early options, with the purpose of bringing the enemy lead echelons to a halt. We postulated that they would be in a conventional posture at that time, presenting more lucrative targets. We would concentrate on the maneuver battalions, and we would only use divisional size weapons—that means up through the Honest John—with the purpose primarily of stopping the lead divisions for one to three days while they considered what they were going to do. This gives us an opportunity to transition to a nuclear posture, deliver the nuclear strike, and be less vulnerable to any countermeasures or reaction by the enemy.

FOWLER: Am I correct that you are more vulnerable to a nonnuclear attack if you are in a nuclear disposition?

PAGE: You have trouble massing to oppose the enemy's massed attack—that is correct.

WALSKE (DOD): In your simultaneous strike, about how many weapons would be used?

PAGE: This depends on the threat. Taking into consideration the changes that have occurred since Czechoslovakia in the upgrading in the readiness of the Warsaw Pact forces, the additional divisions that are in Category I, we postulated in the central region 20 Warsaw Pact divisions as the lead elements of the first echelon. We would go after the maneuver battalions only in these 20 lead divisions. The depth of the attack would not exceed 25 or 26 km from the FEBA, and we would visualize using between 247 and 260 small yield weapons, 10 kt or less in most instances.

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PAGE: We would use those primarily close to the forward edge of the battle area (FEBA), which is where we utilize most of our weapons, by the way. I might point out that in those 125 weapons, we have provisions for restrike, strike RECCE aircraft. The weapons may never be fired. In this consideration, the weapon requirement may drop from 125 down to 90 or so, and the same with the mobility factor. I can't really answer your question on how much we could reduce the number of weapons if we had the longer range, improved tube weapons.

ORR (USARPAC): You said you'd start with the ADM as your threshold— what happened to the Hercules? I can see the Russians coming to the border, but they are going to send their air ahead of them and your threshold is going to be at the Hercules.

PAGE: Let me say, as far as the air defense is concerned, the use of the Hercules could occur before, during, or after use of the ADM; it would depend strictly on the air threat, what kind of a massive attack they launched, and the effect on, or threat to, the maintenance of our nuclear capability in aircraft. Although I didn't mention it here, Nike Hercules air defense weapons may well be utilized long before ADM. They are again essentially defensive.

ORR: This brings out the need for quick release of nuclear weapons, because you have an immediate decision when you see them coming.

PAGE: Selective release procedures, yes.

REP. HOLIFIELD: Why was the Davy Crockett scrapped?

PAGE: I am sorry, I am not in a position to answer that question.

REP. HOLIFIELD: On the theory that you need maneuverability—and this involved only two men in a jeep, and you had between 2000 and 3000 of them in Europe—I just wondered why they were withdrawn, particularly when you say you have 5700 deficit in the tubular units. That is a simple question and someone ought to be able to answer it.

COWAN (3rd Armored Division): I think I can answer. Davy Crockett was brought into the inventory and was actually used the last time, I guess, in the Berlin crisis of 1961. The problems with Davy Crockett were twofold: (1) Since it was essentially a platoon weapon, command and control was a problem, and there apparently was great fear that some sergeant would start a nuclear war; (2) the resources that the Army had to provide to actually keep Davy Crockett in the field were a higher price than the net worth of the weapon at that particular time. In fairness to this weapon, it did represent a significant advance in the technical state of the art, both from the design and the production viewpoint, and I think the laboratory responsible for the design and production deserves a great deal of credit. It is unfortunate that we were not able to fit it into our command and control and manpower system more effectively. I think it was a little bit ahead of its time.

HOERLIN (LASL): I wonder to what extent weather conditions are a parameter in your studies. It seems probable that during the normally prevailing westerly winds in Europe the result will be one thing, but with easterly winds—and there are long periods of easterly winds—the result could be different.

PAGE: This was primarily a weapons requirement study, and consideration of weather was not specifically addressed in this study. You realize that constraints are placed by SACEUR on our use of weapons, as to the number, types of yields, size of yields, and what weapons, if any, can be burst on the surface. Primarily the weapons utilized would be airburst.

HOERLIN: In case of first engagement of the size you described, what is the integrated fallout dose for unprotected populations?

PAGE: By integrated, you mean the total over the whole battle area?

HOERLIN: No, the integrated over time for a particular location.

PAGE: I don't know.

NEWHOUSE (TRW): You postulate a high attrition environment. How do you intend to implement your RECCE strike concept that you talked about?

PAGE: You mean the strike RECCE going out to check whether or not the targets have, in fact, been struck?

NEWHOUSE: I would assume when you talk about RECCE strike you are talking about target acquisition and also the strike. I am concerned about how you intend to implement the target acquisition feature in particular.

PAGE: Again I can merely say that this subject is receiving additional emphasis in the up-date study this year.

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GARBLIK (McDonnell Douglas): DELETED, Will these be phased out of the stockpile?

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PAGE: Our ground systems range up to the Pershing, of course. DELETED. They were available just as they were available here. In other words, this was a limitation placed on the game and not a limitation on the delivery capability that exists.

NELSON (LRL): In your operation plan, you had great emphasis on knocking out the enemy's ability to deliver his weapons on you. Considering the range of FROG and SCUD and the range of the weapons that you have available, how do you intend to knock him out?

PAGE: We considered the use of the Lance as well as the Pershing for the greater ranges. Location of the FROG and some of the others was quite difficult. You would have to use aircraft on some of these targets at the ranges you are talking about.

DILLAWAY (AMC): In you presentation you have three categories of targets in a very tight area; you selected low yield weapons for particular targets with high kill probability, but you also assumed you had good RECCE and command control on this. This, to me, assumes they aren't hitting you, and the result is that you have a mismatch of weapons. Assuming that you do have a condition where the UCM and command and control are not favorable to you, is your new study going to look at using higher yield weapons to approach an area destruction which might result in a more favorable mix?

PAGE: This is one of the things we will look at. Of course we are interested in discrete targeting because we are working in a multinational arena, and we are interested in limiting destruction primarily to military targets. This presents a problem when you are fighting in an industrialized, heavily populated area. In most instances, we try to use the lowest yield, and if necessary, two small weapons rather than one.

NELSON (LRL): This requires that you have good RECCE and good electronics; also your model assumes that you have a great number of targets in a rather constrained area.

PAGE: This is fairly typical, as you will see if you look at the Soviet combined arms army and their disposition, either in conventional or high intensity posture. This is one thing that really affects requirement studies, because you can go into quite a discussion about whether you should base your requirements on what you think you will find or whether you should base your requirements on the actual number of targets that are there. This makes a difference in your results.

FOSTER (SRI): I had the opportunity to do a similar study in 1963-1964 in Europe, and two things bothered me. The first was the general strategic concept advanced under the McNamara strategy of conventional emphasis in the pause. Obviously this hinges on the option of the German concept of no deep penetration being allowable; on the MC 14/2 strategy; and on the political directive of '56 which did not include the concept of a limited war prolonged in scope and in time in Europe. Is that correct? Is this founded on the graduated deterrent concept which accepts the original political directive?

PAGE: We can consider the direct defense, the forward defense, if you will, postulated in the MC 14/3 as a requirement. Initially, we would start fighting the battle conventionally. However, in this particular instance we feel that we must apply nuclear weapons early, within the first one to three days, or risk a serious breakthrough. Remember, I am not speaking for NATO at this time—this is the feeling at USAREUR Headquarters.

FOWLER: One to three days looks like more than one to three hours or minutes. That is the reason I am asking the question. That is not a one to three day operation you had there when you had those ADM's going off right along the political border.

PAGE: No, but this is basically what we feel, within one to three days. Of course it may well occur earlier than that, particularly with air defense weapons. If you have a massive air attack that is going to threaten the survivability of your entire force and your restrike or your strike capability, particularly in nuclear weapons, you might require nuclear weapons a lot earlier.

WHITE (Lovelace): In the tactical context, what do you think is the ideal distribution between artillery and rockets and missiles?

PAGE: You are looking for a percentage?

WHITE: The distribution between artillery and rockets in the Soviets was different from ours, and I wondered if you considered it healthy for us to go ahead and maintain the preponderance of artillery? There is either an advantage or a disadvantage in doing it, and what is it?

PAGE: We would like, of course, to maintain our artillery preponderance capability. We would like to see it extended. We would like to be able to reach out farther with tube artillery weapons accurately, say 30 km, because a lot of the targets we find are in that range. We would also like to be able to counter this MRBM/IRBM threat, which we cannot do right now.

HOYT (Lovelace): Why don't the Soviets have tubular weapons, then?

PAGE: I don't know. Perhaps they could. There is no evidence they do have, as you heard Dr. Ord state, but they have a capability. Perhaps they are not interested in discrete targeting; maybe they are interested in area concepts.

COWAN: I'd like to refer to the question before the last one with regard to MC 14/2 versus 14/3. General Burchinal pointed out yesterday that there is a significant change in the strategy which NATO plans to employ in 14/3 as compared with the trip-wire concept of 14/2. He brought out the three points—direct defense, deliberate escalation, and general nuclear response. No one has placed a time limit as to when you would go from one to the other, or whether you would ever start with direct defense. Therefore you will see that military assessments of the situation we face in Europe vary in the scenarios, depending upon the specific aspect of the situation which we are attempting to analyze and study.

HAMPTON (OSD-ISA): As I understood your concept, you intend to employ the 12,000 weapons in a band roughly 60 km wide, 30 km on either side of the FEBA.

PAGE: No, the total of 12,000 weapons included those that would be utilized in the division slice in the first 60 km of FEBA. It also included some 900 weapons that would be utilized to attack front targets, particularly the nuclear delivery means, that are deeper than 60 km from the forward edge of the battle area. In other words, we would after the whole threat, not just the 60 km band immediately opposite us. This is if we got into the big battle which would require the 12,000 weapons.

HAMPTON: It is apparent, though, that the major portion of the battle would be fought on NATO territory. This is the thing that's politically unacceptable to our European allies and yet this is what you base your strategy on.

PAGE: The area of the battle, if we fought a tactical nuclear war, would be restricted not just to NATO territory but also to the Warsaw Pact territory. It would not involve the Soviet Union. That is correct.

HAMPTON: But when you speak of 900 weapons out of 12,000, and say that you would use these in the front area, I still have to feel that most of your weapons are going to be actually fired on NATO territory.

PAGE: That would depend upon the depth of penetration that you permitted before you started using them.

GIRARD (RAC):

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If your own resources cannot make a significant contribution in getting fire superiority over the enemy's nuclear threat against you, why do you not direct them primarily against his maneuver elements—in other words, make those your Category I targets for the resources you were talking about?

PAGE: Of course, initially, or at some time in the engagement, the thing that can hurt us the worst is nuclear delivery means. Next, if you can knock out his command and control elements for those things, you have made a big step forward in enhancing your own survivability. I'd like to point out that, in our simultaneous initial strike, we do go after maneuver elements primarily because we want to halt the enemy right then. The things that could hurt us the worst are listed Category I items.

GIRARD: Yes, but they are outside your range of capability, aren't they?

PAGE: Not the FROG.

COGGAN (North Am. Rockwell): Your study was predicated on simultaneous initial effort using ADM's and going after front targets, and it appears that at least in today's environment this is politically unacceptable to NATO. Suppose you had to wait a day before you could get release from Washington (or wherever) to launch this simultaneous attack—how much impact does that have on the total number of weapons you should have at your disposal to win?

PAGE: None whatsoever. The ADM option, as a possible first option, and the simultaneous strike, are possibilities for initial use within our concept. The number of weapons stated in the requirement is based on the total available targets in the threat that is postulated for the study. Therefore, the number of targets does not change. There are 12 to 13 maneuver battalions, for instance, in each division. There is a FROG battalion in each division. Whether we use our step-by-step philosophy or hit all across the front in a simultaneous strike against the maneuver elements in lead divisions, the total number of weapons required to attack these targets won't change.

COGGAN: Then your total weapon requirement and its mix would stand the test of the decision-time-debate as far as working its way through NATO and back into our own country's stockpile?

PAGE: The requirements for this study were based on what targets could be presented by the combined arms army, so that remains fairly constant. In this year's study, this would not bother the mix although it might bother the total number of requirements. We are taking a hard look to see whether you need to hit, say, the 79th division as hard as you would the first division.

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W. C. Myre
Sandia Laboratories, Albuquerque

SANDIA DEVELOPMENTS IN TACTICAL NUCLEAR SYSTEMS

Introduction

A new class of tactical nuclear weapons has been shown to be feasible in exploratory development programs conducted at Sandia Laboratories and in other defense laboratories. These programs envision a family of nuclear weapon systems designed to hold collateral damage to low levels by means of highly accurate delivery of sub-kiloton warheads. These new systems can provide high probability of target destruction with weapon yields that are factors of 10 to 1000 lower than yields required in presently deployed tactical systems. The new tactical systems could provide a variety of presently unavailable use options that would tend to make the US tactical deterrent posture more credible and therefore more effective.

Recent technology advances, particularly in the areas of sophisticated terminal guidance systems and earth-penetration techniques, provide the keys to the feasibility of these new tactical weapons. The Sandia Laboratories' objectives have been to explore the implications these technologies could have for ordnance design; investigate the technical feasibility of new weapons concepts; examine the relative merits of these new systems; and, where warranted, conclusively demonstrate these new options by full system design, assembly, and proof tests.

In a review of the current tactical nuclear stockpile (see Table I and Figure 1) one must be impressed with the diversity of delivery options and yield selections available to the tactical commander.

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Some of the choices that could be made for a particular target

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(representative of a thermal electric power plant) are shown in Figure 2. In this review of present capabilities, however, several other pertinent points become apparent. Because the delivery accuracies (CEP's) that can be achieved with these systems are large, the warhead yields required for an acceptable target kill probability are large: of the order of 1 to 100 kt. Weapon yields of this magnitude result in considerable collateral damage which, in many cases, is not desirable. Affected areas of 5 to 100 square miles are typical. Our willingness to use weapons of this size in close proximity to friendly troops or to defend allied territory is debatable.

However, interesting observations can be made about the yield/CEP combinations in Figure 2: as the delivery system CEP is decreased below 200 feet, the yield required to destroy this target is dramatically reduced, and there is a corresponding reduction in the off-target area affected. Some more specific advantages of accurate systems are pointed out in Figure 3. As can be seen, a significantly smaller yield can be used for successful attack of a given target as the CEP is improved. This chart was prepared for a target vulnerability of 10 psi; harder targets, which require increased yield, demonstrate more dramatically the effects of system CEP. Sandia's efforts have been centered in the area of accurately delivered systems; this paper discusses the effectiveness of three of the new weapon systems that could provide these characteristics:

Bayonet	an earth-penetrating nuclear bomb
Beckett	an air-carried, rearward-fired, IR seeking missile
Nike Hercules Earth-Penetrating Weapon	a new capability for an existing weapon system

TABLE I

Some Current Tactical Nuclear Systems

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System		Range (km)	Accuracy (CEP in ft)
Cannon, 8-inch		16	800
Honest John		38	1000
Sergeant		140	660
Aircraft	Laydown/LADD	-	300
	LABS	-	1200

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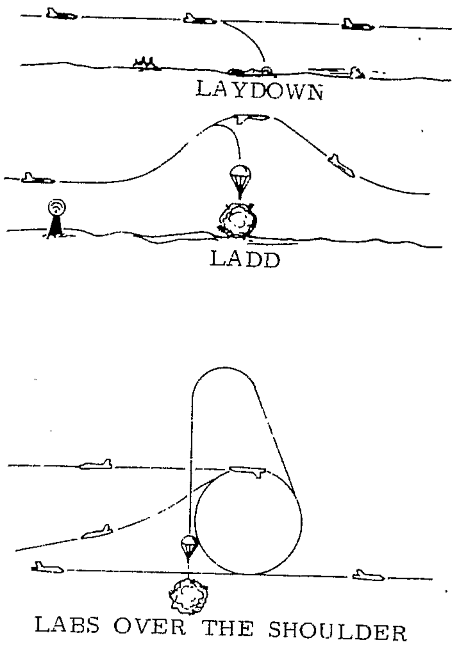
LAYDOWN
LADD
LABS OVER THE SHOULDER

Figure 1. Existing delivery modes

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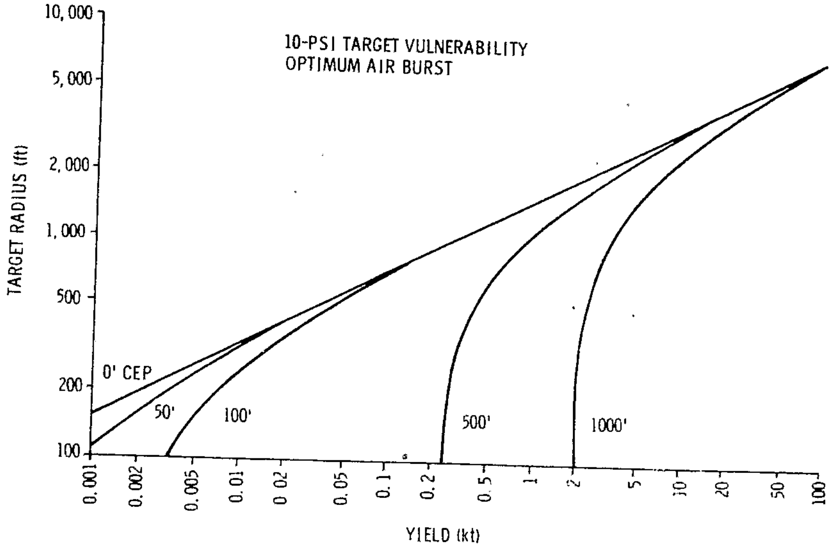

Figure 3. Target radius versus yield required for expected fractional damage ≥ 0.9

The potential advantages of these systems, however, can better be realized by understanding the effects that burst options have upon collateral damage levels. The two most interesting options are subsurface burst at optimum burst depth for the yield in question and airburst at optimum altitude for the yield in question.

Subsurface Nuclear Bursts

There has long been an interest in earth-penetrating weapons. However, in past efforts, the penetration data acquired were scanty, and the characteristics of both the projectile and the soil were inadequately described. In late 1960, studies were initiated at Sandia to investigate high-speed soil penetration phenomena. These were later broadened to include penetration of water, concrete, and a wide spectrum of soil types. This program has grown into a new science, called terradynamics, which is defined as that branch of dynamics which deals with the motion of soil and other solid materials and with the forces acting on bodies in motion relative to those materials. In Sandia's efforts, over 1000 field penetration tests have been conducted in earth materials including rock, glacial ice, soils, bay muds, and water; a broad spectrum of vehicles, shapes, launching, and impact velocities have been tested. Analytical results are now available which allow reliable prediction of penetration performance. The penetration nomogram (see Figure 4) is based on the results of this effort. Typical penetrators (see Figure 5) are characterized by a high length-to-diameter ratio (10 or greater), high frontal loading (10 psi or greater), and pointed nose. The terradynamics program has provided a firm technical base from which vehicles capable of penetrating the earth to depths of 200 feet can be confidently designed.

A low-yield nuclear weapon capable of penetrating the earth a few tens of feet before detonation offers the following major advantages:

1. The prompt effects of thermal and nuclear radiation associated with atmospheric nuclear detonations are eliminated.

2. The fallout resulting from an underground detonation is localized within a few crater radii. As an example, the area of 10 R/hr at 1 hour may be reduced by factors of from 25 to 100 over comparable-yield surface-burst weapons.

3. A given-size crater can be formed by 2 to 4 percent of the yield required for the same size crater from a surface-burst weapon. The improvements that can be made in yield and fallout reduction are shown in Figures 6 and 7.

Figure 6 depicts the weapon yields required to produce three constant-size craters (131-, 77-, or 48-foot radius) as a function of detonation depth. As can be seen, for a crater radius of 77 feet a surface burst of 2 kt is required. The same size crater can be provided by only 40 tons buried to a depth of 50 feet. The combination of this yield reduction plus the radiation containment provided by burial will result in the fallout area reduction shown in Figure 7. For the previous example, the fallout area is reduced from 10 square miles for surface burst to 0.1 square mile for bursts at 50-foot depths.

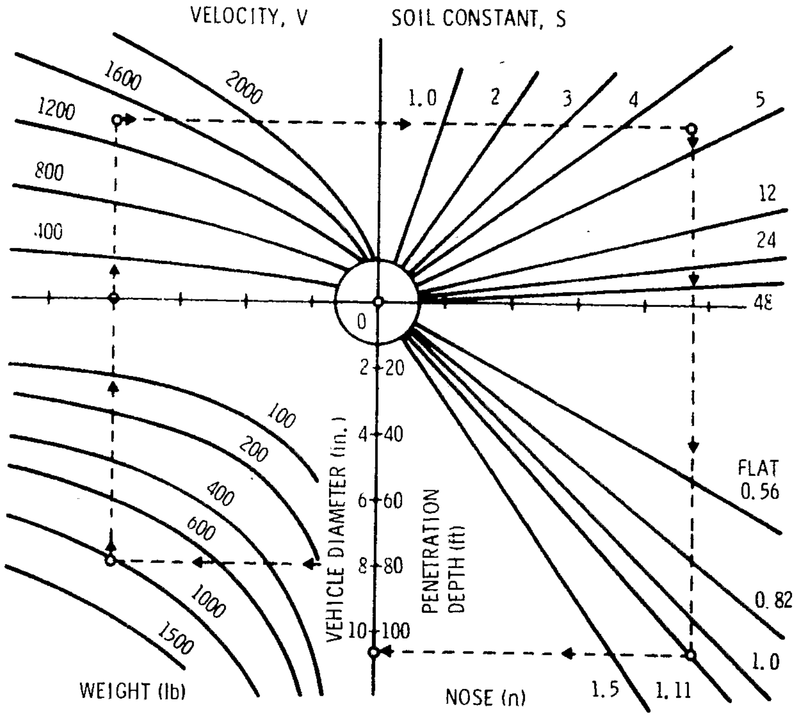

Figure 4. Earth penetration nomogram

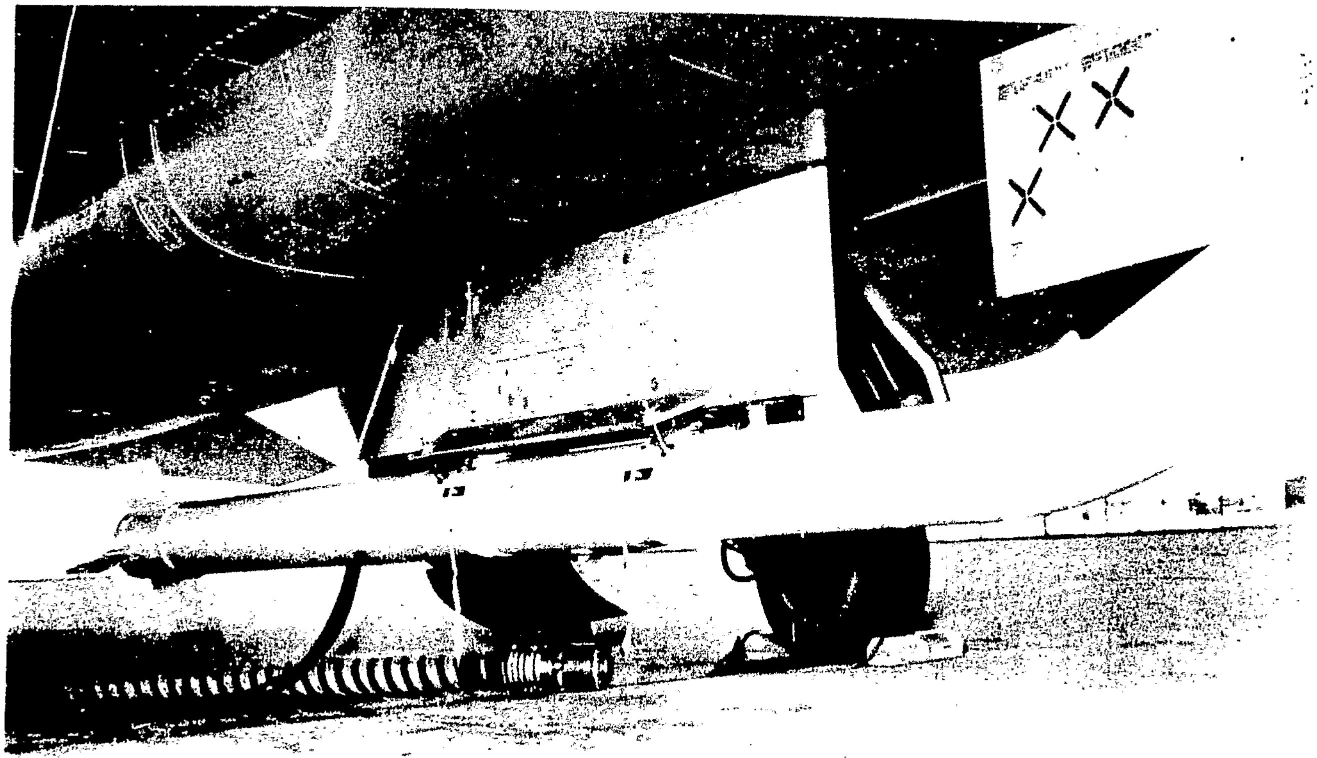

Figure 5. Typical REB vehicle

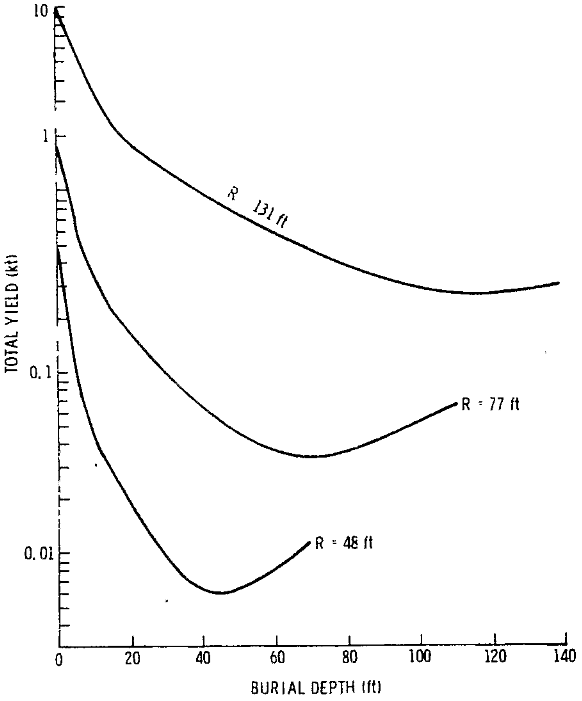

Figure 6. Yield required to create a crater of given radius versus depth of burial

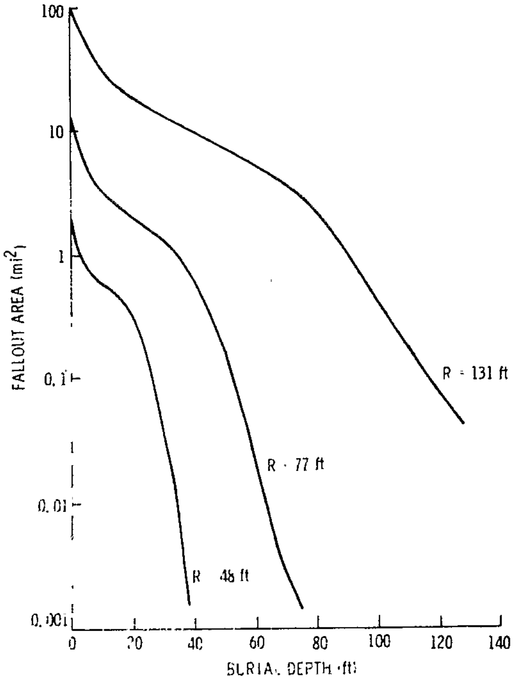

Figure 7. Area enclosed by the 10 R/hr fallout contour at H+1 versus depth of burst for constant crater radius

The target spectrum for accurately delivered penetrating systems includes very hard targets such as bridge abutments, buried command posts, buried POL dumps, runways, railyards, caves, bunkers, or any target that can be defeated by cratering. In summary, it appears that major improvements can be made in the efficiency of the stockpile and in reducing collateral effects by providing accurate low-yield earth-penetrating options.

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Nuclear Airburst

In this investigation, airburst is defined as a detonation at sufficient altitude above terrain to prevent the weapon fireball from touching the ground. Under this condition, three weapon effects are optimized from the standpoint of maximum area covered for a particular yield: prompt radiation, thermal radiation, and air blast. At the same time, fallout for this burst condition is minimal. A comparison of the effects of airburst and surface burst against the softer targets indicates that the area covered by a given blast pressure level is approximately doubled for airburst over the same yield surface burst. The fallout zone, on the other hand, is essentially reduced to zero by airburst. Although many existing systems have an airburst option, certain deficiencies are apparent. In particular, present bomb delivery accuracies are not compatible with low yields. Furthermore, LADD and LABS delivery techniques increase aircraft vulnerability in a heavy defense environment. Low-yield airburst weapons might be directed toward such targets as buildings, radars, hangars, missiles, POL dumps, revetted aircraft, SA-2 sites, and personnel.

New Systems

Although a number of new tactical nuclear systems studies have been undertaken by Sandia and others over the past several years, this has been a period in which new strategic systems have received the preponderance of national effort; no new tactical nuclear system has entered the stockpile. Of the new tactical systems described here, Bayonet and Beckett are examples of air-to-surface systems and the Nike Hercules EPW is an example of a surface-to-surface system. These were selected because, collectively, they demonstrate many of the improvements that could be made in a tactical capability.

Bayonet

Bayonet is an earth-penetration, low-yield nuclear bomb designed for low-level, high-speed delivery. The Bayonet system (see Figure 8) is composed of an earth-penetrating body housing the warhead and the fuzing system, combined with an aerodynamic surface which provides lift and trim stability for a dive maneuver. The vehicle is designed to permit wings and tail to shear from the penetration body at impact so that penetration is achieved by a cylindrical vehicle with good terradynamic characteristics. A shaped charge which fires at impact is included in the nose to enhance vehicle performance at low-impact angles into hard materials such as concrete. When the vehicle is on the aircraft (see Figure 9), its wings are positioned at zero-degree incidence to the airstream to minimize drag. At release, the wing is explosively driven to an incidence angle of -16 degrees with respect to the airstream, and the Bayonet dives in a 900 foot radius arc into the target. This trajectory is independent of release velocity.

The Bayonet system was successfully demonstrated in an extensive advanced development program conducted jointly by Sandia Laboratories and the Air Force Weapons Laboratory. Three successful full-scale prototype air drops were conducted at Sandia's Tonopah Test Range in March and April of 1966. In August of 1966, simulated weapon release tests made at White Sands Missile Range by TAC pilots indicated that a range error probable (REP) of less than 100 feet can be obtained with this system. In late 1966, additional air drops of Bayonet centerbodies with shaped charges demonstrated the capability for penetrating concrete runways at incidence angles as low as 20 degrees to the target surface. Bayonet possesses many of the desirable characteristics previously discussed. System CEP of 80 feet can be met. Earth penetration depths of 10 to 70 feet can be achieved; types of soil, release velocities, and altitude determine the specific penetration capability.

Beckett

Beckett was an exploratory development program that demonstrated the feasibility of a rearward-fired tactical missile capable of delivering a subkiloton warhead with a CEP of 50 feet. The general system concept is shown in Figure 10. As the delivery aircraft passes directly over the target, two infrared (IR) flares integral to the bomb are fired rearward (with sufficient velocity to cancel the forward velocity of the aircraft) and downward, thus marking the target. Typical flare trajectories are vertical, with a downward velocity of 100 to 200 feet per second. A fraction of a second after the flares are fired, the bomb is automatically released from the delivery aircraft and a small parachute is deployed. After sufficient bomb-to-aircraft separation distance is achieved, the parachute and aft vehicle section are jettisoned and an IR seeker head is exposed. Simultaneously, a solid-propellant rocket motor, which accelerates the bomb back to the marked target, is ignited. The seeker head provides steering control to jet vanes in the rocket exhaust. The primary fuzing mode is a down-looking IR sensor for either airburst or near-surface burst, although timer and contact backup fuzing are also provided. The bomb, which can be delivered from altitudes between 35 and 200 feet, is programmed to return to the target at an altitude of 40 feet, the nominal airburst altitude for yields of 20 to 100 tons. The complete Beckett weapon is shown in Figure 11. The Beckett concept was demonstrated in an exploratory development program that culminated in a successful full-scale prototype flight test from an F-4 aircraft at Tonopah Test Range.

A major variable in the concept was the ability of a pilot to fire the target-marking flare guns directly over the target. A large number of flight tests were conducted with combat-qualified pilots to test their ability. It was determined that, with minimal training, pilots could probably be expected to perform this task while flying low level and to achieve CEP's of 50 feet or less.

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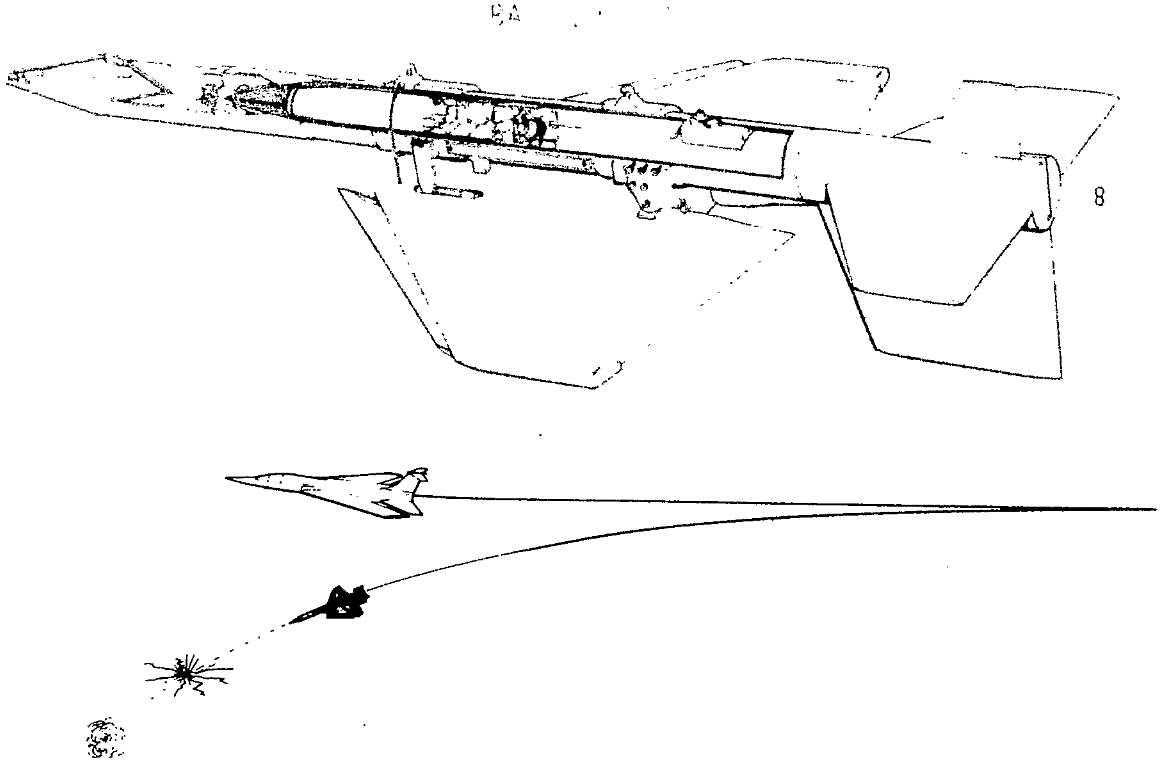


Figure 8. Bayonet configuration

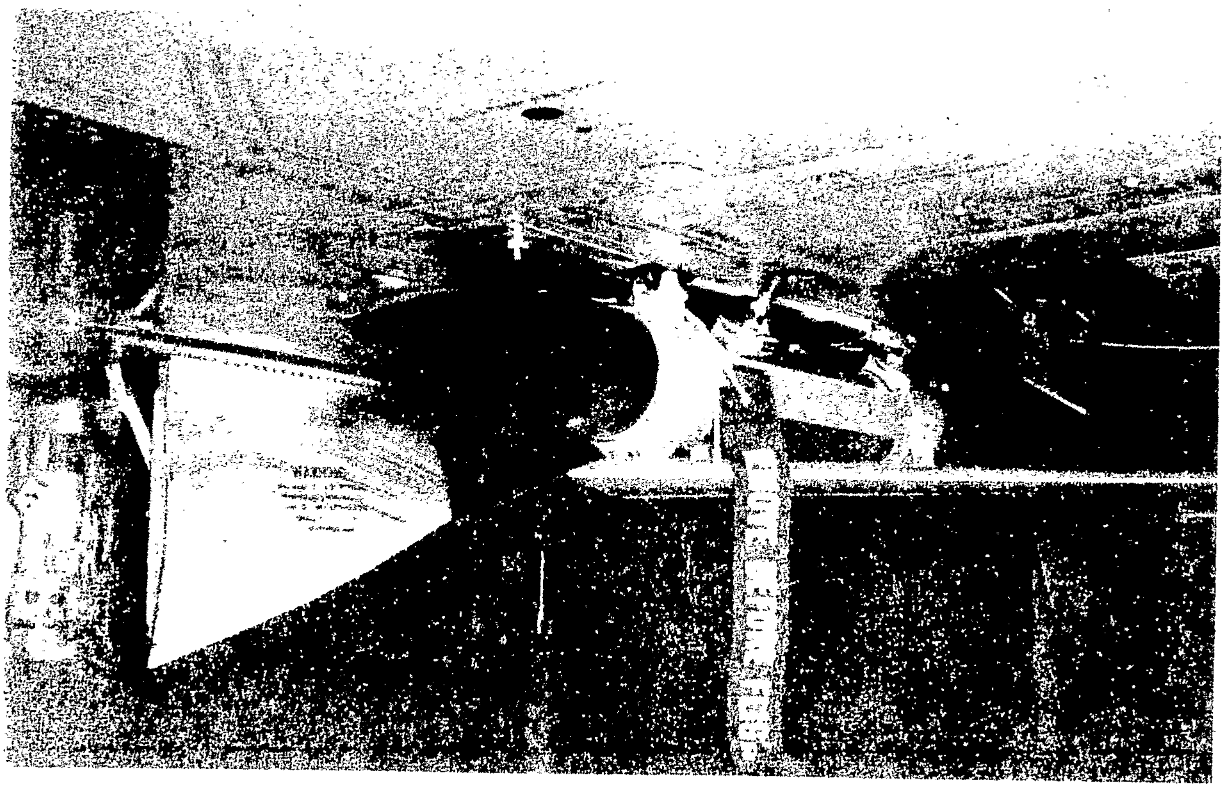
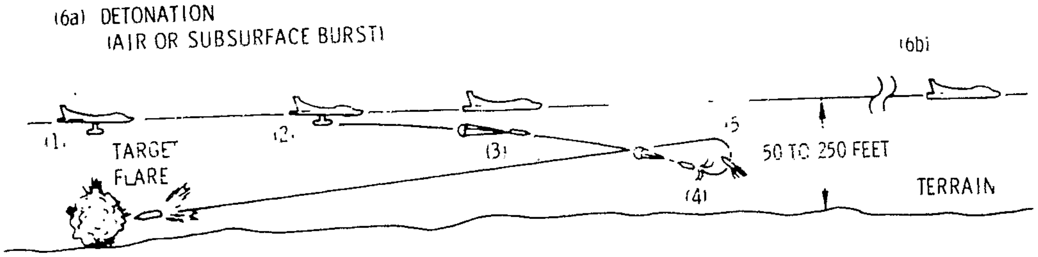


Figure 9. Bayonet

[redacted]


(6a) DETONATION
(AIR OR SUBSURFACE BURST)
(6b)
(1)
(2)
(3)
(4)
(5)
TARGET FLARE
50 TO 250 FEET
TERRAIN

	T	X
1. FLARE GUNS FIRED	0 SEC	0 FT
2. BOMB RELEASED	0.53 SEC	424 FT
3. PARACHUTE FULLY OPEN	0.88 SEC	702 FT
4. PARACHUTE JETTISONED	1.53	1038 FT
5. MAX BOMB RANGE FROM TAR	1.13	1177 FT
6a. DETONATION OVER TARGET	4.18	0 FT
6b. SAFE ESCAPE DISTANCE	4.18	3,440 FT

TIMES & DISTANCE ARE FOR A RELEASE SPEED OF 800 FEET/SECOND.

Figure 10. Typical Beckett trajectory diagram

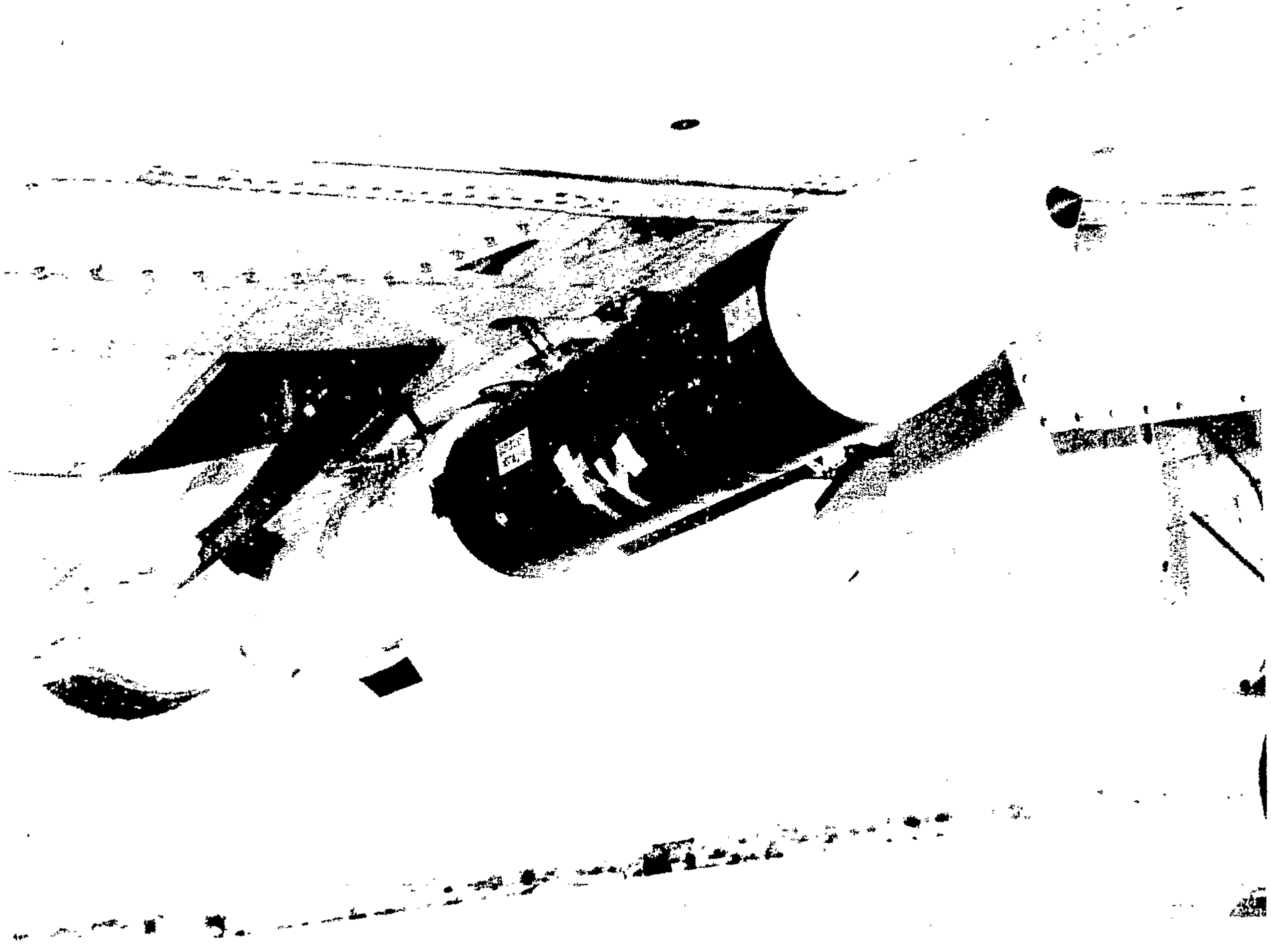


Figure 11. Beckett

Since the conclusion of the Beckett feasibility study, follow-on studies have shown that a retrocede system based on Beckett can be built to deliver an earth-penetrating system in addition to the airburst system that was tested. It now seems feasible to provide both an earth-penetration option or airburst option in a single, low-level delivered bomb.

A Beckett-like system should provide a valuable complementary delivery option to nuclear standoff systems now in development, since it appears that there is a continuing need for low-level delivered, over-the-target systems.

Nike Hercules Earth-Penetrating Weapon

The Nike Hercules system, although primarily an air defense system, has an accurate (CEP ≈ 150 meters) surface-to-surface mode. The Hercules is deployed in the United States, Europe, and Asia in large numbers, and present plans call for phasing some of the missiles out of the inventory. At a meeting, early in 1969, with the Army's Combat Development Command, Institute of Nuclear Studies, Sandia Laboratories was asked to consider the technical feasibility of providing an earth-penetrating option for the Hercules missile. Although no hardware could be made available for a feasibility demonstration, a quick systems study showed the feasibility of this concept.

In the surface-to-surface mode, the Hercules system performs as shown in Figure 12. The target coordinates are stored in the target-tracking radar, the computer flies the missile to a point in space directly over these coordinates, and the missile dives directly into the target. Prior to passing below the radar horizon, the control surfaces are "trimmed up" and the guidance system is turned off. The missile continues on into the target from that point.

The system modifications studied are shown in Figure 13. The replacement of the existing warhead by an earth-penetrating weapon (EPW) is a relatively straightforward modification. The Hercules guidance unit would be moved aft to provide the required length, and a terminal guidance system would be added. The target would be marked with a small x-band beacon that could be emplaced in a number of ways. The missile would generate terminal steering commands from the beacon as shown in Figure 14.

A number of existing guidance systems could be modified for this application, and the Sandia study indicates that it is feasible to make these systems compatible with the Hercules control system. It appears possible to achieve a 20-foot CEP (referenced to the beacon) with this technique where, at impact, the earth penetrator would separate from the Hercules missile, enter the earth, and detonate at depth.

If the beacon were preemplaced, this system could attack targets which now require atomic demolition munitions (ADM's). In that all major subcomponents of this system are in existence, this seems to be a relatively inexpensive way to achieve a rapid earth-penetrating, surface-to-surface missile capability.

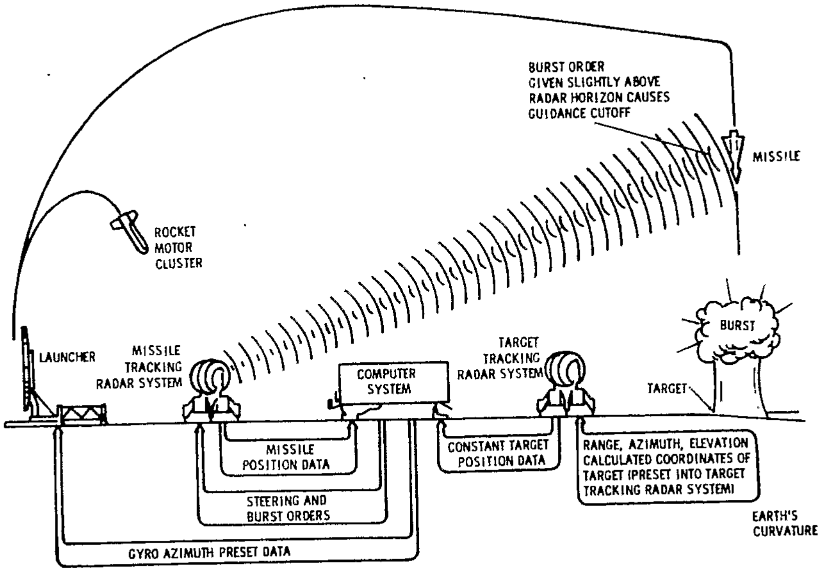

BURST ORDER
GIVEN SLIGHTLY ABOVE
RADAR HORIZON CAUSES
GUIDANCE CUTOFF
MISSILE
ROCKET
MOTOR
CLUSTER
BURST
LAUNCHER
MISSILE
TRACKING
RADAR SYSTEM
COMPUTER
SYSTEM
TARGET
TRACKING
RADAR SYSTEM
TARGET
MISSILE
POSITION DATA
CONSTANT TARGET
POSITION DATA
RANGE, AZIMUTH, ELEVATION
CALCULATED COORDINATES OF
TARGET (PRESET INTO TARGET
TRACKING RADAR SYSTEM)
STEERING AND
BURST ORDERS
EARTH'S
CURVATURE
GYRO AZIMUTH PRESET DATA

Figure 12. Surface-to-surface mission

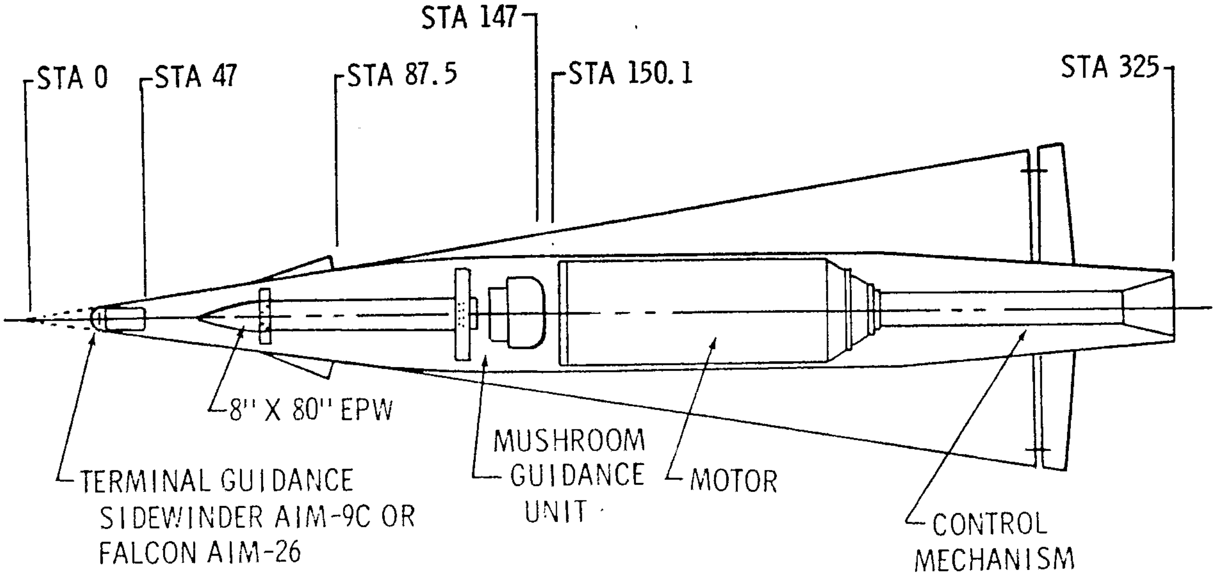

STA 147
STA 0
STA 47
STA 87.5
STA 150.1
STA 325
8" X 80" EPW
MUSHROOM
GUIDANCE
UNIT
MOTOR
TERMINAL GUIDANCE
SIDEWINDER AIM-9C OR
FALCON AIM-26
CONTROL
MECHANISM

Figure 13. System modifications

[redacted]

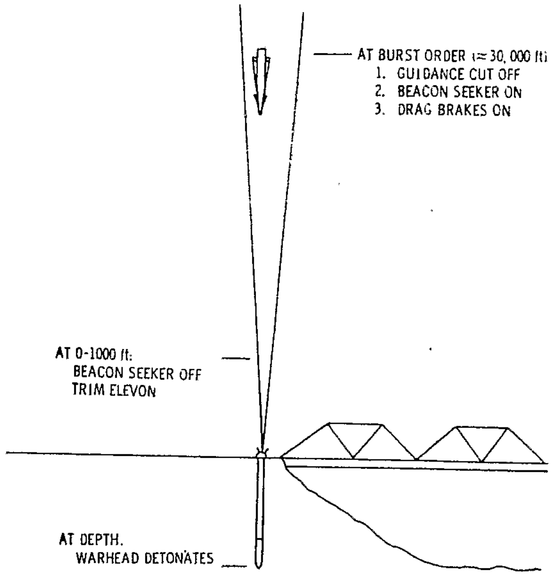


Figure 14. Hercules

Effectiveness of Accurate Systems

An extensive Beckett system target analysis which indicates the yield required for various targets and the associated collateral damage levels that could be expected for these yields has been completed. The yield required for a comparable kill probability with existing over-the-target bombs is included for comparison. Three example targets from the analysis are presented. The collateral effects levels that were used are shown in Table II. Total collateral damage area for surface burst, optimum airburst, and subsurface burst (30-foot depth of burst) versus yield is shown in Figure 15. The predominant effect is indicated on the appropriate portion of each curve. Although this analysis was done for Beckett, it should be kept in mind that it applies to any system that offers CEP's of 50 feet or less with the appropriate burst options.

Figure 16 depicts the yield required as a function of target kill probability for attack on a thermal electric power plant. A power plant would represent a small, soft target. It can be seen that a Beckett system with a yield of 20 tons provides a P_k of ≈ 1, whereas other bombs require yields ranging from 1 to 10 kt for comparable P_k's. For this class of target, Beckett allows a yield reduction over existing bombs of 10 to 500. If the maximum allowable collateral damage limits are set as shown in Table II, the Beckett yield reduction corresponds to a reduction in collateral area affected of from 5 to 60 square miles with existing systems to less than 1 square mile with Beckett.

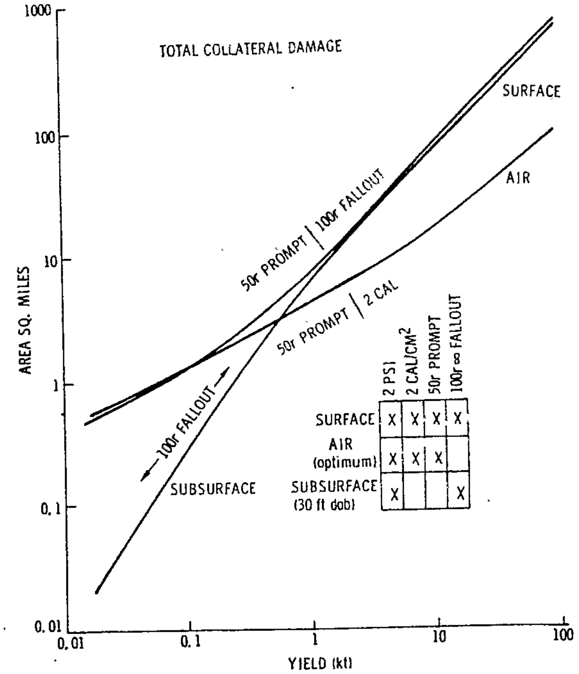


Figure 15. Total collateral damage

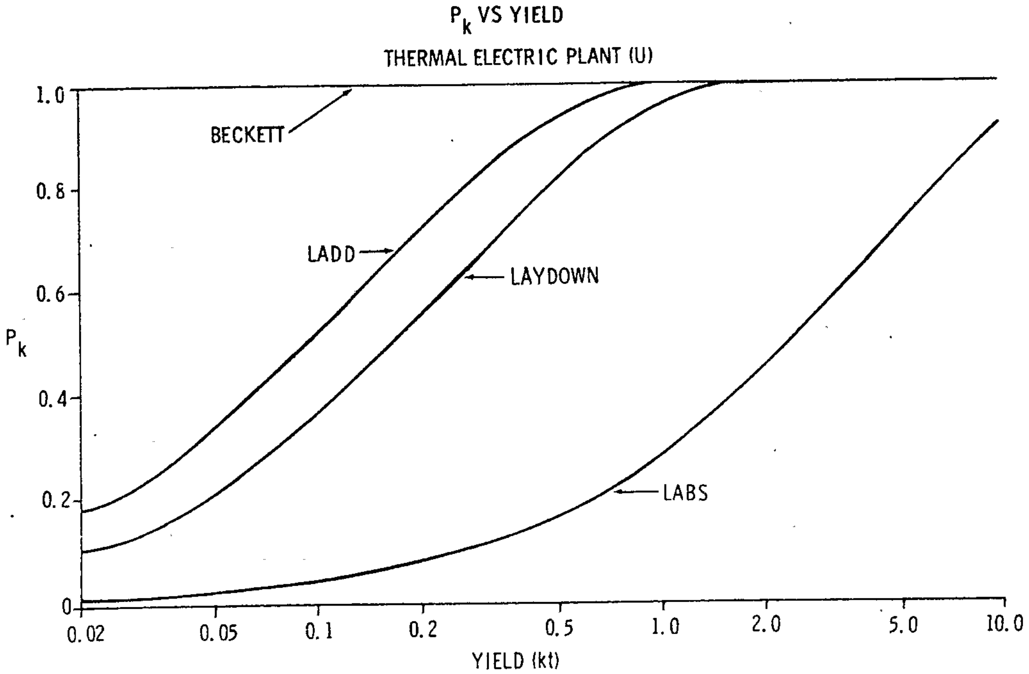


Figure 16. Thermal electric power plant, p_k versus yield

TABLE II

Collateral Damage Limits

Maximum allowable effects levels:

Overpressure	2 psi
Thermal	2 cal/cm^2
Initial Radiation	50 rads (relative air density P = 0.8)
Fallout Radiation	100 rads - dose downwind (20 knot effective wind)

A second target considered is an SA-2 site, an example of an area target. Figure 17 depicts weapon yield as a function of the fraction of the target covered. A Beckett yield of 100 tons is adequate for complete target destruction, whereas other bombing techniques require yields of 1 to 10 kt. The area affected by collateral damage is reduced an order of magnitude.

Another type of target considered in the analysis is an extremely hard target that must be within the burst crater to be destroyed. Yields around 1 kt are adequate with an accurate earth-penetrating delivery system. The yields increase to about 10 kt for an accurate surface burst system, whereas yields in excess of 1 megaton are required with other delivery techniques to achieve comparable kill probabilities. Collateral effects, of course, increase by several orders of magnitude with the increased yields. This target is shown in Figure 18.

Conclusions

Weapon systems in our present stockpile require high-yield warheads to achieve acceptable target kill probabilities, resulting in large areas affected by undesired collateral effects. Technological progress made in the recent past can now provide delivery system accuracies with burst options that were not possible at the time the current stockpile was required. As has been shown, exploratory development programs conducted at Sandia and at other laboratories throughout the country have demonstrated that a new class of tactical weapons is now feasible. These new systems can provide a high probability of target destruction with weapon yields that are factors of 10 to 1000 less than yields required by deployed tactical systems. The corresponding reduction in undesired collateral effects that accompanies these low-yield weapons is even more impressive. Collateral effects can typically be reduced to areas less than 1 square mile compared to areas of tens to thousands of square miles for existing tactical systems. If developed, the new systems would make available to our military planners a new set of options for responding to possible enemy action. This would make available a more responsive, effective, and credible nuclear force which could provide a capability for using nuclear weapons under battlefield conditions or for discrete applications of force.

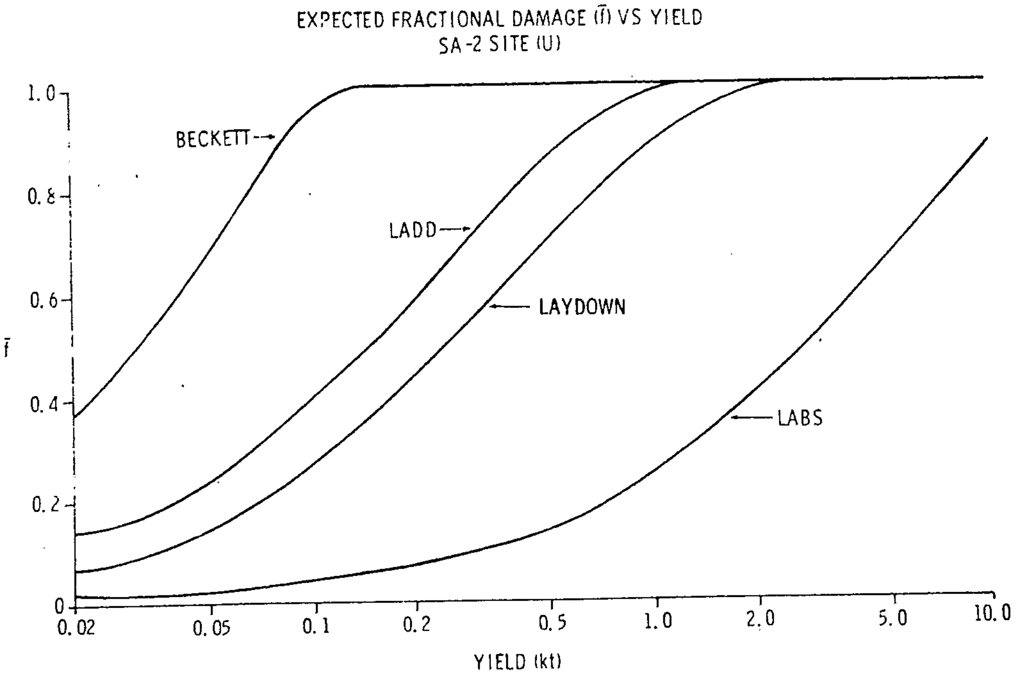


Figure 17. Expected fractional damage ($\bar{f}$) versus yield, SA-2 site

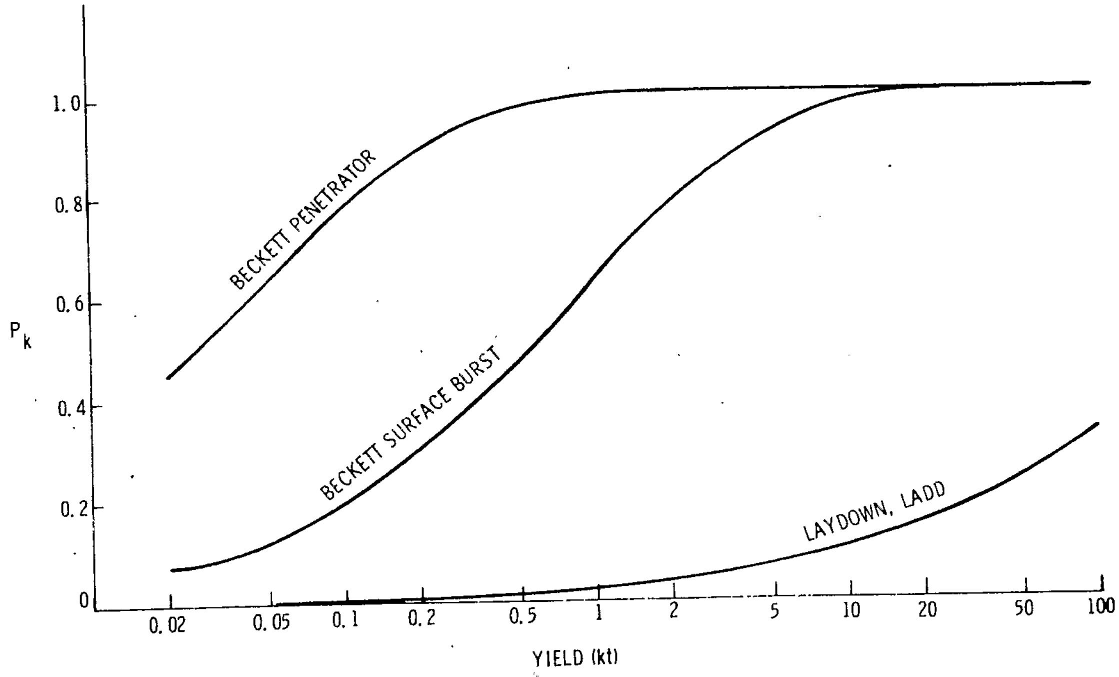


Figure 18. Hard-point target, p_k versus yield

Question and Answer Period

GARWIN (IBM): If you considered not 50 foot CEP but a hitting missile, what fraction of the targets can be attacked by nonnuclear ordnance?

MYRE: We didn't look at that to get that particular number. Of course a great number of targets that are fairly small or soft you can kill with conventional HE, but I don't know what the fraction of available targets would be.

ROWNTREE (NWC, China Lake): We have some Vietnam combat experienced Air Force pilots and able aviators in the crowd. I'd like one or more of them to comment on the delivery profiles that seem to be required for Beckett and Bayonet.

MYRE: We started the Bayonet and Beckett program before Vietnam, and low level delivery was a good option. In Vietnam, if you have to go on repeated sorties, it is not considered very good. However, we talked to people in Europe, and it is considered the way to fight there.

GLASSER (R&D, USAF): I can comment on the Air Force opinion regarding this sort of delivery tactic: It is a good thing that the weapon is ejected 1/10 second after you cross over the target, because that way you might get the weapon off the airplane.

FOWLER (DDR&E): Could you comment on the accuracy of the flare delivery being affected by the variable speed of the aircraft—that is, the need to hold a particular speed to get the flare dropped to the accuracy that your system required?

MYRE: Yes, the downward velocity is so great that we can stand a fair range of speeds but not the total range. Essentially you have to come in with a canned mission and hit that within 50 knots or so, and it doesn't degrade. The big problem is the pilot being able to hit the button when he is directly over the target. We did look at a system and found it is possible to build in a velocity measuring device that would decide how hard to kick out the flare, but we decided that it wasn't worth the effort. We should be able to can the mission to 50 knots or so.

OVERBY (North Am. Rockwell): I didn't understand how you fuzed that weapon for your airburst. Could you give us a little insight into that?

MYRE: It was fuzed for airburst with a downward-looking, narrow beam IR seeker. As you went directly over the target the IR seeker was looking straight down; when it saw the flare it would be the firing signal.

OVERBY: Have you done enough analysis on that technique to know whether it will give you the accuracy you are looking for?

MYRE: Yes, the beam-width, I think, was something like two or three degrees, and when you are 20 or 30 feet up in the air that hardly affects the accuracy.

COGGAN (North Am. Rockwell): Would the missile use this IR seeker to home in?

MYRE: No, two different IR seekers, one for guidance to home in.

HOERLIN (LASL): How far is it from the flare to the turn-around point?

MYRE: How far down range does the Beckett go? It is something less than 1000 feet. The airplane is 4000 or 5000 feet down range at that detonation time.

HOUSE: When you talked about the statistics for the target or the airplane coming over the target, I don't recall that you described the kind of targets or terrain you used for those statistics. Could you repeat that?

MYRE: The National Guard pilots trying to find the target? It was flat New Mexico land. Obviously more study of this kind of thing would have to be done.

McCARTHY (CINCLANT): What are the chances of other IR sources in the target area setting the weapon off?

MYRE: The flare is very bright.

McCARTHY: I mean IR sources that possibly your infrared system would come across before it reached the flare itself.

MYRE: The system is fairly insensitive and the only thing we felt we would have any trouble with was the sun, or somebody trying to set off another flare somewhere else.

McCARTHY: How would that affect your airburst capability?

MYRE: If the seeker head sees the sun it will try to guide toward the sun, but in general it has a fairly narrow beam that it is looking into, and so long as you are not flying directly away from the sun, at close to sunset, I don't think there would be any problem.

ETHRIDGE (Aberdeen): I didn't understand General Glasser's comment on the release time of the weapon after the aircraft passes over the target. Do you mean that the Air Force considers the lifetime of the vehicle only fractions of a second after it passes over such a target?

GLASSER: (Concurred with Mr. Ethridge's comment.)

(Speaker Unidentified): We seem to test in the flat and fight in the mountains. What degradation do you get in a differential altitude as far as marking the target is concerned? Say you have to mark 200 feet, how much effect will that have on identifying the target? In other words, there are targets in the mountains that you can't get within 50 feet of, and you have to release, say, 300 feet above the target. What effect does this have on your IR marking flares?

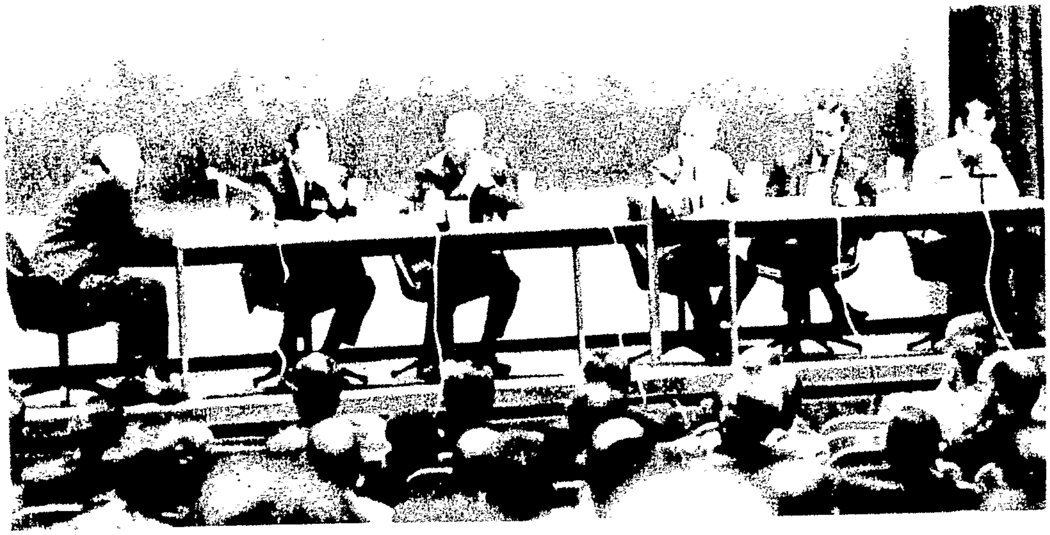
MYRE: On the flare itself, it would have very little effect. It will degrade the pilot's ability to know when he is directly over the target; at 300 feet it is not quite as good as it is at 50 feet. So the CEP of his ability to know exactly where he is, would be degraded slightly, but it would hardly change the flare at all.

NELSON (LRL): I noted that the delivery velocity was in excess of Mach 1, so my first question is, have you looked at the problems of carrying external stores at that speed? I believe currently there are no such stores except possibly the B58 pod. Secondly, in laydown accuracies the most significant factor is altitude, and it is the most difficult problem. I would comment that in excess of Mach 1 at 50 feet, maneuvering in combat conditions would be very difficult, and I wonder if you have looked at the sensitivities of the various parameters involved?

MYRE: I think in general we plan not to deliver in excess of Mach 1. I think the point made was that we built the thing with enough thrust in the rocket motor to stand velocities that high. I don't think in actual practice it really matters what your velocity is.

NELSON: You previously mentioned a 50 knot band or something like this.

MYRE: Sorry, it was in the delivery of the flare system that you had to know before the mission what your planned velocity was within 50 knots. Then if you stayed within 50 knots, the accuracy in placing the flare would not be degraded.



Maj. General Otto J. Glasser
Assistant DCS/R&D

USAF TACTICAL NUCLEAR CAPABILITIES DEVELOPMENT PROGRAMS AND LONG RANGE GOALS

While the rigid bipolar confrontation of East versus West has lessened over the past several years and many predict that it will continue to do so as third countries exercise greater independence, the fact remains that the ideologies of Soviet communism and US democracy remain in competition. As we have heard earlier, our national interest and potentially the freedom of lesser powers are opposed by the significant military capabilities not only of the Soviet Union and Red China but also a number of other countries within their spheres of influence and to whom they supply modern weapons.

In the most general sense, US security policy has sought to develop a world community of free and independent nations each secure from the threat of aggression and each respecting basic human rights and the rule of law. We in the military, while supporting these goals completely, also recognize the importance of retaining a strong military posture. I think it is generally agreed that our strategic nuclear deterrent has provided the umbrella under which we have been able to pursue normal avenues of negotiation and diplomacy in resolving our differences. A part of this capability has been provided by our tactical forces in their support of the single integrated operations plan (SIOP). Additionally, however, these tactical forces also provide us with the capability of responding at varying lower levels of conflict. I would like to review with you the tactical nuclear portion of this overall spectrum of capability—touching briefly on desired delivery and weapon system improvements and current work on several hardware development programs, and concluding with a summary of our long range goals.

Currently our USAF tactical fighter force is deployed with 17 squadrons in the US, 22 squadrons in USAFE, and 42 squadrons in PACAF, for a total of 81 squadrons.

Excluding the imbalance due to the war in Southeast Asia, our concept is to station that portion of our forces overseas necessary to respond to immediate contingencies while maintaining the remainder in the CONUS ready for rapid world wide deployment.

To arm this fleet of aircraft, stockpiles of tactical nuclear weapons are positioned and strategically located. Alert procedures have been established and, as you know, depending upon the current international political situation, a certain number of aircraft stand ready to respond within minutes of any aggression.

USAF nuclear capable fighters are as shown in Figure 1. While the bulk of the force is composed of the F4, both the F105 and F111 have advanced radar delivery systems, and the F111 has an automatic terrain following flight control feature which permits target penetration at 200 feet AGL and up to 600 knots at night and in all weather. Traditionally we think of these fighters as being employed against interdiction type targets with tactical nuclear weapons, but they also can be employed in the close support role over a wide range of targets and with considerable strike/weapon flexibility. Employing ground beacons, the F4, and to a greater degree the F111, can perform this support function around the clock and in all weather. As will be shown later, both systems have good range capabilities and this can be converted into longer loiter times if desired.

CURRENT DELIVERY SYSTEMS

System	Capability
F100	Mach 1.4 Day, Night Visual
F105	Mach 2 Day, Night Visual, Radar All-Weather
F4	Mach 2 Day, Night Visual, Radar All-Weather
F111	Mach 2 Day, Night Visual, Radar All-Weather

Figure 1

Figure 2 shows several typical missions overlaid on Western Europe. Radii depicted here are for aircraft, not air-to-air, refueled and cruising at optimum altitude with penetration to the target at low altitude for approximately 250-300 nautical miles. Most significant is the fact that both weapons and delivery systems can be based outside of the immediate battle area, thus enhancing survivability while still being responsive to immediate combat needs. Because of the aircraft's speed and range capabilities, en-route diversion is possible to higher priority targets or those posing a more immediate threat.

Our reaction times can be measured in only a few minutes. Additionally, command and control techniques permit the highest state of readiness, including airborne alert should advance intelligence indicate the need.

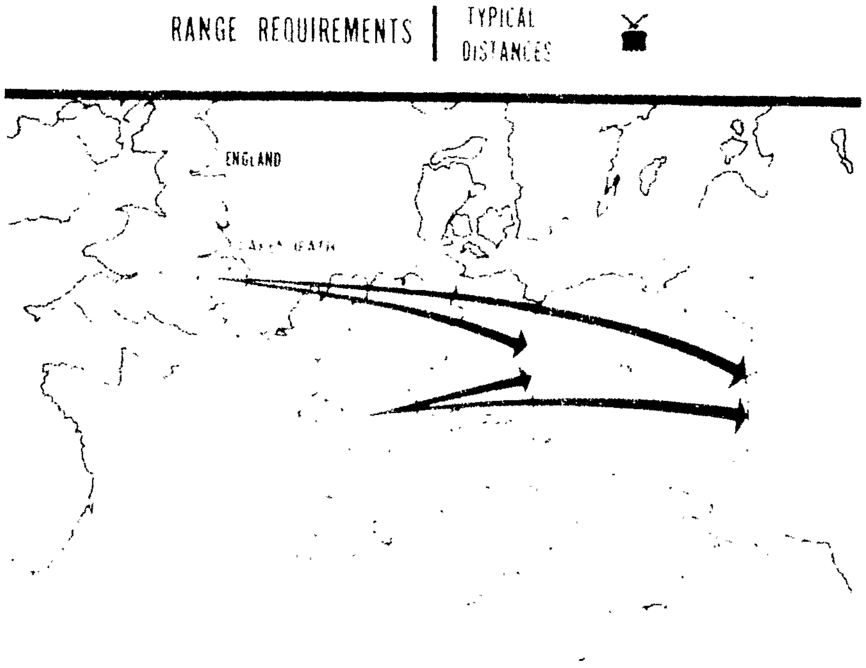


Figure 2

As the enemy has improved his defensive capability, the tactical fighter has also been provided with new equipment to defeat or counter these enemy systems (see Figure 3). Radar homing and warning equipment has become a standard piece of hardware; electronic counter measure pods has been built for each of the fighters, and the F111 comes equipped with several additional aids such as chaff-flare dispensers and tail warning devices. While operations in SEA have shown this equipment to be extremely effective, experience has also demonstrated the dynamic and everchanging nature of electronic warfare. We cannot afford to rest on our laurels in this field.

PENETRATION AIDS

F100	RHAW, ECM Pods
F105	RHAW, ECM Pods, Mini-Jammers, Terrain Avoidance Radar
F4	RHAW, ECM Pods, Mini-Jammers
F111	RHAW, Internal Jammers, Chaff-Flare Dispensers, IR Tail Warning, Terrain Avoidance Radar

Figure 3

Our delivery systems are capable of carrying all available tactical air deliverable weapons in the stockpile, including the Mk 28, Mk 43, Mk 57, and Mk 61 (see Figure 4).

DOE 6.2(a)

DELETED

Figure 4

As a maximum load, the F105 could carry and deliver as many as four Mk 57 weapons on a single sortie, the F4 three, and the F111 six. Actually, a more realistic load would be two weapons and three tanks for the F4, for example, and four weapons and two tanks for the F111. These configurations will provide the penetration ranges as previously shown or the corresponding loiter time. In-flight refueling capability will permit loaded aircraft to take off and hold during periods of extreme tension or during a critical decision period, thus reducing vulnerability and minimum response time.

Currently, none of the available tactical weapons have terminal guidance or more than a very limited standoff delivery capability. Obtaining these two items constitutes the major portion of our future requirements. Optional yields currently available appear to adequately satisfy requirements when coupled with today's CEP's; however, as a higher degree of accuracy is obtained, these yields can be reduced and thus the potential for collateral damage can also be reduced.

High value tactical targets can be expected to be heavily defended against air attacks in the 1970-77 time period. Defense weapons will in all probability consist of SAM's, AAA, small individually served missiles similar to Redeye, and manned interceptor aircraft with both guns and air-to-air missiles. Figure 5 depicts a recent intelligence estimate of the extent of these defenses in several potential trouble spots around the world. Again experience in Vietnam has shown that providing such defenses can be extremely profitable for the Communists in terms of drain on US resources versus defensive investment. The mobility of these systems provides the defender with the potential of shifting and concentrating his equipment, almost at will, to the most vulnerable, highest value, or most probable target.

ENEMY AIR DEFENSES 1968

Country	AAA Weapons	SAM Batteries	Manned Interceptors
North Vietnam	7400	32	150
North Korea	850	29	434
Cuba	1450	25	155
China	3900	37	2800
UAR	840	38	175

Figure 5

New delivery options must be provided which can offset improved defenses. One way of minimizing attrition is to avoid the defenses in the immediate target area by launching weapons from standoff distances greater than the defense's effective range. This requirement for a standoff capability is a function of the estimated performance of improved US countermeasures, the enemy's determination to defend, and/or the importance assigned to a specific target and our determination to attack that target. While improvements are certain in both offensive and defensive systems, the offensive advantage at any given time is problematic and thus argues for a standoff capability.

Figure 6 indicates the average circular error probable (CEP) for the delivery mode and maneuver considered. Safe separation distances are provided by utilizing high and low angle release times in conjunction with free fall ballistic shapes or parachute retarded weapons. Fuzing devices in the weapons may be set for either air or ground detonation. As can be seen, our best bombing accuracies are presently obtained by low altitude, drogue-retarded laydown deliveries, where we can expect a 300 foot CEP under visual conditions and a 1500 foot CEP under all-weather conditions. When toss bombing delivery techniques are used, these CEP's can be expected to increase to 900 feet for visual and 2000 feet all-weather (JSTPS Planning Manual Tab B, App II, Chapter 8).

The significance of delivery accuracy and its direct effect on required weapon yield can be seen in Figure 7. Thus, we see that if toss bombing could be eliminated as a delivery mode, or the CEP's could be brought into line with laydown deliveries, there would be little need for yields in excess of approximately 10 kt to destroy point targets, with the exception perhaps of underground command centers. Certainly, yields of the order of 350 kt should be adequate for most area targets struck during tactical operations in limited wars.

LIMITATIONS ON ACCURACY

	Average CEP
Free Fall	500 ft
Retarded Delivery	800 ft
Toss	1500 ft
Laydown	300 ft

Subject to windage, and delivery system inputs altitude, airspeed, G-loading

Figure 6

REQUIRED YIELDS VERSUS CEP

CEP	Tanks	Steel Bridge	SAM Site	MSL Dir Radar
3000	2.7 mt	900 kt	160 kt	145 kt
2000	630 kt	260 kt	55 kt	28 kt
1500	350 kt	240 kt	23 kt	14 kt
300	2 kt	0.5 kt	0.2 kt	0.2 kt
125	0.2 kt	0.1 kt	0.1 kt	0.01 kt
25	0.01 kt	0.01 kt	0.05 kt	0.01 kt

CEP's are for Pd - - 0.9

Figure 7

In selecting tanks as a point target, it was not my intent to suggest that tanks are worthwhile tactical nuclear targets, but rather they were picked to illustrate a very hard above-surface target.

From this brief review, we can conclude that most important in our development activities is the requirement to increase the delivery accuracy of our weapons systems. Further, we need to expand our delivery capabilities to include night all-weather operations as well as a standoff delivery capability so that the delivery vehicles can remain clear of enemy point defenses.

To aid in responsiveness and flexibility, we should continue to investigate earth penetration weapons. As we all know, crater size for a given yield is essentially a function of the depth of burial at the time of detonation. A penetration weapon can be particularly effective against hardened or underground facilities as a result of the ground shock produced.

Air delivered deep penetration weapons could be used in establishing physical barriers rapidly and accurately. Although there is, today, no air delivered nuclear weapon capable of deep earth penetration, the AEC has tested prototype systems and is capable of building warheads and fuzing systems which can withstand the high impact forces.

Furthermore, it may be possible to add a short delay to the fuzing options proposed in the full fuzing option bomb (FUFO) which the joint chiefs have requested as a replacement for the older Mk 28 and Mk 43 weapons currently in the inventory. If this new weapon could be designed to withstand moderate earth penetration (perhaps only to the length of the weapon itself) without an excessive weight penalty, its utility might be significantly increased.

Since 1967, the Air Force has been pursuing the development of a terminal guidance capability for use with conventional bombs. Ultimately, we may find these systems also have application to tactical nuclear weapons as well.

These development activities have involved not only electro-optical techniques but laser, infrared, LORAN, DME, and radar systems as well. Each, of course, possesses particular characteristics which tend to either limit or recommend them for weapon terminal guidance application as can be seen in Figure 8.

SUMMARY OF GUIDANCE TECHNIQUES

	Laser	Contrast EO	IR	LORAN	DME (Steer)	Area Correlation Radar, EO
Limits	Illum. VFR Semi-active	Daylight VFR Launch & Leave	Radiation Contrast	Exact Target Fix	Previous Recon Data	Radar Imagery From Previous Data Active
Advantages	Strap on Kit Form Inexpensive	Passive	Passive Day or Night	Long Range All-WX	Night All-WX Attack Non-RDR Targets	Very Accurate

Figure 8

Very quickly, we might re-cap the more important items on Figure 8. Current laser systems require that the target be illuminated which, in turn, requires an aircraft to remain in the target area. In addition to the increased exposure to enemy defenses, this requirement also poses significant problems as related to flash blindness when the system is used to guide a nuclear weapon. While solutions to these problems are not impossible, they may significantly increase complexity and cost. The fact that the system is semiactive may also prove to be a limitation. In "strap on" kit form, this could possibly be the cheapest of the systems; however, such a scheme has not proved to be feasible to date for existing tactical nuclear bombs.

Present electro-optical systems require daylight, VFR and good contrast. They also possess the advantage of a launch and leave capability along with passive operation.

Infrared equipment requires a radiating source or contrast in IR energy level between the object and its background. Target identification and discrimination as well as information necessary to reach a judgment for final arming is, to date, extremely limited with this sensor.

Radio grid systems such as LORAN and DME (steer) require prestrike target reconnaissance data. These are perhaps the least accurate of the systems listed. They are all-weather and offer potentially the longest standoff ranges. Current proposals retain the signal processing and computer functions within the launch aircraft with the weapon carrying only a retransmitter; thus cost and complexity are reduced.

Finally, area correlation devices are being investigated using both radar and EO sensors. Electro-optical correlation guidance systems have in tests demonstrated 2-3 foot accuracies, making them perhaps the most accurate. They are subject to the same delivery restrictions as straight EO and radar devices. Incorporation of inertial guidance for midcourse guidance will permit longer standoff ranges. Radar correlation can provide night all-weather guidance.

To a varying degree, work is being accomplished in all of the guidance areas I have just mentioned. However, for terminal guidance of nuclear weapons, electro-optical and area correlation techniques appear to be most suitable and offer the greatest number of advantages. In each case, the principle involved is to compare the object, or real time sensed ground scene, with either a prestored reference of the desired target area prepared from prior reconnaissance, or a snapshot reference obtained just prior to missile launch. Within the reference scene, the desired target aimpoint is designated and correlation is obtained when the reference and live images are aligned. Once correlation has been obtained, the missile is given steering commands to achieve and maintain a terminal trajectory. Worthy of note is the fact that, since the technique makes use of the total informational content of the area scene surrounding a target, the target itself need not actually be visible. That is, a totally camouflaged target, with no inherent contrast, can be designated as the desired aimpoint and the missile still guides to that desired point on the ground using the remainder of the scene to correlate on.

Goodyear Aerospace Corporation has produced a unique electronic tube which performs these comparison functions almost instantaneously and with a high degree

[redacted]

of accuracy. This system also compensates for the blooming and magnification of the image as the vehicle and sensing device approach the target at steep angles. The system memorizes its last view of the target just prior to changing magnification and then uses this as a new reference for comparison.

A slit scan area correlator has been developed which shows promise in providing terminal guidance. Aligned with the gunsight in a tactical aircraft is a slit scanner which records the varying intensities of light from a target area and places them on a memory drum. A similar target scanner operates in the nose of the weapon on board the aircraft and may be slaved to the sight scanner by movement of an acquisition switch in the cockpit. At any time after this correlation has been achieved, which is indicated by a light, the pilot may acquire a target instantaneously in his sight picture and initiate weapon launch. Subsequent to weapon launch, aircraft tracking is not required and the weapon will guide on the memory scan recorded on the drum at the instant of firing. Actual launches show a tracking accuracy CEP of 2.9 mils, which was recorded during 13 test launches at an average slant range of 40,000 feet.

As most of you are aware, with the exception of the nuclear versions of Walleye and Condor (both of which were approved in 1969), no air delivered tactical nuclear weapons project has been initiated since the Mk 61 bomb entered engineering development in 1962. Thus such guidance and control work as has been going on has been in conjunction with conventional munitions and delivery systems.

The conventional Walleye, which is an air-to-ground glide weapon employing an edge tracking TV guidance control system, has been combat tested in Vietnam with very acceptable results.

DOE 6.2(a)

DELETED

OSD 6.2(a)

A video uplink to the aircraft to monitor guidance system performance and a command arm downlink are to be incorporated into the system. Thus it will be possible to arm the weapon after it has been determined that it is locked onto the desired target and all systems are functioning satisfactorily. The video uplink and command downlink equipment is to be pod-mounted so that it can be carried on an inboard wing pylon station of the F4. The weapon will initially be adapted to the F4D aircraft having the improved scan converter displays. Within the constraints of range, contrast, and visibility requirements inherent within the guidance system, the 15 foot design CEP of this weapon will provide a significant improvement in repeatable accuracy. This represents the first step in our long range plans to improve our tactical nuclear capability.

Potentially a follow-on to the nuclear Walleye might be the AGM-X-3, which is currently in the concept formulation phase of development (see Figure 10). This 3000 pound missile would provide the desired increase in standoff ranges—50 nautical miles when launched at sea level, and over 100 miles when launched at 40,000 feet. It would also be capable of incorporating, in its modular design, a radar area correlator for all-weather guidance, as well as the EO guidance system. Targets against which this missile could be employed are not only the normal interdiction and counter-air ones but also enemy defenses.

[redacted]

NUCLEAR WALLEYE

- Program Approved - April 1969
- AF Designated as Cognizant DOD Development Agency
    - Video Uplink
    - Command Arm Downlink
- I.O.C. - April 1970

Figure 9

To date, neither our own studies nor those of either the Joint Chiefs or the Unified Commanders have shown valid reasoning or justification to support reducing our air delivered tactical nuclear weapons inventory below its present level. The future requirement for an improved tactical nuclear capability is considered essential. We believe a portion of that inventory should consist of a medium to long range, highly accurate, all-weather air-to-ground nuclear armed missile.

Without addressing specific numbers, you will note that today our inventory contains only bombs (see Figure 11). With the introduction of the nuclear Walleye, we will have a terminal guidance capability and from there, I would hope we can go on to achieving an all-weather night capability and marry this to a long range standoff missile.

The recent decision to build additional Mk 61 bombs I feel is a good one. Hopefully, AEC production capacity can be adjusted to permit the tactical weapons to be produced immediately following those designated for the strategic forces.

We in the Air Force are pursuing priority development, testing, and procurement of the command and control equipment required for the nuclear Walleye.

Finally, as I have indicated before, we will continue our efforts to develop an accurate all-weather terminal guidance system which initially, perhaps, would be used on a short range air-to-surface weapon as early as FY 74, and later on a longer range standoff weapon.

AGM-X-3 MISSILE

Missile Standoff Range

Launch Altitude (ft)	Velocity (Mach)	Range (nmi)
500	0.8	70
40,000	0.8	150
40,000	1.8	250

Description

Total Weight	3,000 lbs
Candidate Modular Warheads	1,000 lbs, Blast/Frag, Penetration, Bomblet, Low Yield Nuclear
Candidate Modular Guidance	Radio Triangulation (DME, LORAN), CEP: Less Than 100 Ft EO Area Correlator, CEP: 10 Ft Radar Area Correlator, CEP: 35 Ft
Standoff Range	S.L. Launch Greater Than 50 nm 40,000 Ft Launch Greater Than 100 nm
Trajectory	Semiballistic With Solid Propulsion, Low Level With Pop-Up if Ramjet Used

Figure 10

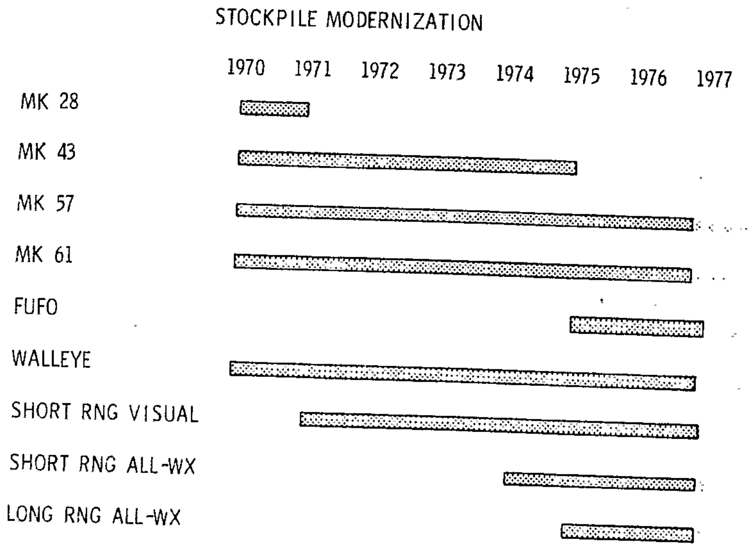


Figure 11

Question and Answer Period

KUPFER (NWEF): Have they solved the problem that they ran into in Southeast Asia with the Walleye where the North Vietnamese were setting off white smoke generators to confuse the guidance system?

GLASSER: I don't know. Perhaps Mr. Crawford will be addressing that.

CRAWFORD (NWC, China Lake): There are serious problems in attempting to use smoke generators, and we haven't had any reports that this technique has been very effective.

COGGAN (North Am. Rockwell Corp.): Recognizing that there are limitations inherent in any particular type of guidance sensor, IR or EO or whatever, do you not see the possibility of a dual sensor capability in some of our future missiles—having more than one guidance capability that can be integrated?

GLASSER: No question that that would be an ideal solution to the problem. We have approached this on the Pave Way series, which has a laser, an IR, and an EO head that are interchangeable. They use the same steering system, but you can change the sensor on the front. Conceivably you could do that on missiles. I think, however, you are suggesting that you have all these capabilities at once, and here you run into a cost problem.

COGGAN: We have to find some way to accomplish a true all-weather capability; we don't have it, as I see it today.

GLASSER: We do not have it; and the nearest hope for this is the radar correlator, and that, of course, gets degraded CEP again.

GARWIN (IBM): You noted as a liability for some of those guidance methods that one had to determine location of the target before the flight. In many of the others you have to determine the aspect or make the decision to attack. I just wonder, in practice, what fraction of the targets attacked are essentially prebriefed and located?

GLASSER: I think essentially all of them are prebriefed in current experience. Whether this would be true in Western Europe is problematical. I think that if we were operating in support of land armies, as we would be in Western Europe (quite differently from what we are doing in Southeast Asia), there would be a lot more, particularly in the armored category, and in troop concentrations, APC's, and this sort of thing, where they would not have been prebriefed.

GARWIN: Why do you prefer the correlator to a bomb which is released and guided by a remote TV, like Walleye?

GLASSER: I am not sure this is the right answer. My own view is that I like the notion that the missile is now on its own and no longer needs any connection with the airplane at all.

OLIVER (NWEF): Do Air Force long range plans include air-to-air missiles?

GLASSER: Yes. The fact that I didn't comment on them is perhaps an oversight from the standpoint that I didn't include the air-to-air portion of the tactical program. The so-called dog-fight missile is on the books now for what it sometimes called the short range missile, SRM, which is to go with the F15 as a new weapon. I believe this also is to be used by the Navy.

McDONALD (LRL): I was sorry to hear that the AGMX is suffering the pains of several of our other systems; certainly we shouldn't leave the impression that that is going to be the end of it. It seems to many of us that these standoff missiles have a tremendous future for you, and I hope we will see them come back in. We do have the nuclear Condor coming along, which can have some Air Force application as well. I suppose one might even consider some future systems normally categorized as strategic as having some interest in these areas, under the right circumstances; for example, the SRAM or SCAM or SCAD, or things of this kind.

GLASSER: Yes, you are quite right. I thought I said that this was a postponement. It was a cancellation for this year, but certainly without prejudice, and we anticipate being allowed to reinstate the program when money comes back in style.

SCHRIBEL: In response to your long range goals, it appeared to be restricted to the 1970-1977 time frame. The Army and Navy publish a long range technological forecast. I am wondering if the Air Force is also planning to undertake such an effort?

GLASSER: Yes, we do put one out. We have a personal bias towards those. We have gone back through the years and read some of the long range forecasts--you have probably done it too. Remember Bush's famous statements on ballistic missiles and so forth? Very interesting reading. Anything beyond about five years we find rather difficult to make use of.

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Jack A. Crawford
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China Lake

TECHNICAL ASPECTS OF THE CONVENTIONAL WALLEYE AND CONDOR SYSTEMS

Introduction

Good afternoon. In my talk I will discuss the Walleye and Condor weapon systems as they currently exist with conventional high explosive warheads. In a way these weapons are out of place in a tactical nuclear weapons symposium for though they are tactical they are not as yet nuclear. In another sense, however, discussing them is quite appropriate, for application of these weapons or the technology they employ to the tactical nuclear field will allow a precision of warhead delivery and control not previously possible. This precise control may in turn affect the acceptability of using the weapons by allowing the use of lower yield warheads and minimizing the damage to other than the desired target.

Walleye

I will describe Walleye first since it is the simpler of the two weapons and is now in service use by both Navy and Air Force. Figure 1 shows two Walleyes on the wing racks of an A4 aircraft while Figure 2 lists the prime targets for Walleye. The common characteristic of all these targets is that they tend to be point rather than area targets. That is, the targets have one or a few points at which detonation of high explosive warheads will destroy a large percentage of the targets' value. Figure 3, showing a railway bridge in North Vietnam immediately after being severed by a Walleye, illustrates a typical target. This figure also shows the prime reason for the development of Walleye. Note the large number of bomb craters spread around the target, the result of previous attacks with unguided ordnance. These craters represent many costly yet futile sorties into enemy territory. Indeed the general indiscriminate damage caused by these attacks is likely to increase the enemy resolve to resist rather than reducing his effectiveness.

In this connection, I should remark that the studies of nuclear warheads for Walleye and Condor have concentrated on determining the size needed to assure target kill without considering to any extent the subsidiary damage inflicted upon adjacent areas or populace. I believe that a further look which takes into account the desirability of minimizing undesired damage would result in a choice of warheads substantially smaller than now specified. As pointed out by other speakers at this symposium, this factor becomes doubly important when considering the use of weapons on one's own or friendly areas.

Returning now to Walleye, its development resulted from recognition of the need for precise delivery of a high-explosive warhead from ranges compatible with the pilot's ability to acquire and identify tactical targets. The weapon itself, shown in Figures 4 and 5, is a cruciform design. The two metallic clamp rings visible in these photos are field breaks joining the forward guidance section and aft control and power section to the middle warhead section. Four fixed quick attach wings with trailing edge control surfaces complete the cruciform design. Figure 6 shows a cutaway of the weapon. The forward guidance section contains a gyro stabilized television camera, and camera and tracker electronics. The center section which forms the main body of the missile is the warhead with its associated fuze, safety and arming device. The air scoop contained in this section is a pop-up device released by a lanyard at launch to sense ram air pressure as an input to the arming sequence. Finally, the aft section contains the control electronics, a hydraulic servo, and a wind driven generator which supplies 3 phase 400 cycle primary power to the missile. Note the roll gyro which provides an input to the control section maintaining the missile roll stabilized during flight. An additional fixed trim input to the control section causes the missile to fly at approximately 1 g lift in the absence of a guidance signal.

In operation, the pilot visually acquires and identifies the target and maneuvers to place his fixed sight on target. He then transfers attention to his TV monitor, which shows the target as seen by the missile's TV camera. The double cross-hairs define a small region of the TV picture which is gated into the guidance circuitry to generate tracking signals. The pilot maneuvers to place the target within the gated area and switches to automatic track. If the tracker is tracking properly, the displayed picture will remain on target independent of aircraft motion. This lock-on sequence can be accomplished in 5 or 6 seconds. At pilot option the weapon is released and the aircraft is free to break away. At release all connection to the missile is severed and the automatic tracker guides the weapon to impact. As the target is approached, the tracker will refine its aim, always seeking the point of highest visual contrast within the original gated area. Figure 7 shows that the missile seeks part of the bridge structure as it approaches the target.

Figure 8 shows the glide range of the missile as a function of launch speed. Because the glide range will usually exceed the range at which the pilot can acquire the target, it was not necessary to use a propulsion unit on Walleye. The 1 g trim signal mentioned earlier causes Walleye to fly an approximately straight line from the launch point to the target. Note that the missile has as much as 5 nm range when launched at the same altitude as the target. The missile simply glides, trading speed for lift.

Returning now to the seeker section, Figure 9 shows the seeker in its external housing. The lens, part of the gimbal system, and the large "flywheel" gyro are visible through the nose window in this view. Figure 10 shows the seeker with its forward housing removed. In this view, the gyro wheel with its balancing marks is visible along with the lens and gimbal system. Figure 11 summarizes the characteristics of the current Walleye tracker. The camera is conventional and operates on essentially US commercial TV standards. Although the current camera has a 50 mr field of view with a 3 mr gate, a new camera and tracker are being designed which will have a 35 mr field of view and a 1.5 mr tracking gate, potentially doubling the tracking range on any given target.

Figure 12 shows ranges achieved with the present unmodified seeker in captive tests under conditions of good visibility. Operational ranges are reduced from these figures by haze or smoke or the desire to hit a specific point on the target rather than accepting a hit anywhere on the target.

Turning now to the warhead, Figure 13 shows the warhead in the present Walleye. It is an 8 jet linear shaped charge carrying 430 (0.0002 kt) pounds of HE in an 825 pound warhead. Figure 14 shows a test firing in an arena with witness plates spaced 20 and 50 feet from the warhead. The jets are clearly visible. Note also the vaporific effects where the jet strikes the witness plates.

Finally, Figure 15 summarizes Walleye's combat record in the Navy and Air Force launches. To be fair, I should mention that Air Force launches were made at somewhat longer average range than Navy launches. This fact probably accounts for the poorer Air Force hit percentage. On this chart "success" means a weapon which functions properly and guides to a point within the gated area at the time of launch, while "hit" refers to weapons which actually hit the desired target. Since over 50% of the weapons launched impact on the desired target, Walleye can be said to have a CEP of zero.

I will now show some film illustrating Walleye in operation. The first sequence shows Walleye being launched from an A4. Next is a film made from video tape of the telemetered picture as a Walleye flew from launch to impact against a B29 test target and a film showing impact of a live warhead Walleye against the same B29. Next is a film made in combat of a strike against the Tam Da Bridge; finally a film of a Walleye test drop using an experimental data link. The missile was launched at the target area from a range (10 nm) beyond visual acquisition range of the specific target. As the missile nears the target, the operator in an aircraft 10 miles behind the launch aircraft refines the lock-on point to achieve a direct hit on the bridge target.

Condor

Condor, shown in Figure 16 on the wing of an A6A, is being developed to extend the accurate delivery provided by Walleye to longer ranges. The Condor mission, Figure 17, is to attack targets of the same types as Walleye, but from launch ranges beyond the lethal range of SAM defenses located in the vicinity of the target. An analysis of Vietnamese experience shows that although overall loss rates were low, the attrition against selected targets in the Hanoi and Haiphong areas was high enough to justify the cost of a Condor on a purely economic basis.

The Condor weapons system, Figure 18, consists of the missile, a data link pod, and the aircraft internal system composed of TV display, control panel, and control stick. The missile, Figure 19, consists of a seeker and autopilot section, a warhead, solid propellant rocket motor, and a control, power and data link section. The guidance and autopilot section are similar to the Walleye guidance section but with several important differences. The seeker has a switchable lens providing wide (30°) and narrow (6°) fields of view at the operator's option and can be slewed by the operator independent of missile motion. The autopilot section provides mid-course trajectory programming with a variety of glide, climb, and altitude hold options available both preset before launch and by operator command after launch. Also the autopilot can program a turn of up to 90° after launch to permit offset launches.

The warhead, Figure 20, is similar to the Walleye design but is somewhat smaller because of the weight and space occupied by the propulsion section. The propulsion section, Figure 21, was recently switched from a liquid design to the end burning solid design. This motor provides a single 3 minute burn at a thrust level of 880 pounds to produce a range from high altitude launch in excess of 55 nm.

The data link and control section, Figure 22, contains the data link unit, control actuators, a silver-zinc battery, and a power conversion unit. The data link transmits the TV picture from the missile to the launch aircraft and receives commands from the aircraft.

The aircraft pod, Figure 23, carries the matching TV receiver and command transmitter which with forward and aft antennas has a usable range in excess of 100 nm. The computer provides several functions. It performs a built-in test before launch, indicates range to go to launch, and computes missile position after launch. Missile position is computed by combining range and bearing of the missile derived from the data link with aircraft position from the aircraft navigation system. This missile position is then compared with the track from preset launch coordinates to the target coordinates, and if an error exists commands are automatically sent to correct the missile's midcourse track.

While the initial aircraft for which Condor is configured, the A6, has an adequate navigation system, provisions are left in the pod for adding an inertial platform if it is desired to put the system on aircraft not so equipped.

The mission recorder makes a film record of the mission from launch to impact, providing a permanent record for damage assessment and en-route recon. Finally, the environmental control system is simply an air conditioner to maintain desired operating temperatures in the pod.

Figure 24 illustrates the antenna coverage available from the pod. The two antennas provide 360° azimuth coverage so that the aircraft has substantial freedom to maneuver after launch without interrupting data link communication.

Figures 25 through 28 illustrate a typical mission sequence starting with selection of a launch point, navigation route, and checkpoints. En route to the launch point an in-flight check is run by the built-in test system, and target and launch coordinates are set into the computer. In addition, missile cruising altitude is set into the missile. At launch the aircraft turns away from the target, the missile and pod antennas begin tracking each other, and the missile autopilot commands the preset midcourse program. The operator uncages the seeker and can slew the camera looking for checkpoints on the way to the target. Should cloud cover or other conditions be different from predicted, the operator can override the preset program and command the missile to climb, glide, hold altitude, and turn right or left as needed. As the missile nears the target, the operator locates the target area, then the target, and switches to terminal mode. At this point, the midcourse program is canceled and the missile now responds to seeker inputs to fly toward the designated aimpoint. The operator has the option of allowing the missile to track automatically in the same manner as Walleye or he can retain manual control of the seeker to either update the aimpoint or guide manually to impact.

Figure 29 lists the important features other than basic standoff range provided by Condor. Of these, the last—aimpoint selection and correction—is probably most significant. The operator is in control of the missile to the moment of impact. He can change aimpoint, even change target within limits, and abort the mission or destruct the missile if the circumstances dictate.

29

In addition to the basic TV seeker, an alternate radar seeker, Figure 30, has been designed for Condor to extend operation to all weather. This seeker has been captive flight tested for over two years against a variety of land and sea targets and has demonstrated the ability to map land areas and track targets as needed for Condor guidance. The system is ready for free flight demonstration but has not been funded for this program extension.

Studies of the feasibility of surface launching Condor have shown that surface to surface ranges of 30 to 70 miles can be achieved depending upon the booster size used. The launcher can be a simple fixed rail, and the control pod can be located near the launcher or at a remote vantage point.

To conclude, I will show a film made from a video tape of the most recent Condor launch. This missile was complete except for a motor and was launched in a glide mode from an altitude of 29,000 feet above the target and a range of over 14 nm. The missile was deliberately launched with a 2 mile offset from the direction to the target to simulate a tactical situation with errors in midcourse navigation and target location. Performance was excellent, with impact on the predesignated trailer in a group of trailers which formed the target complex.

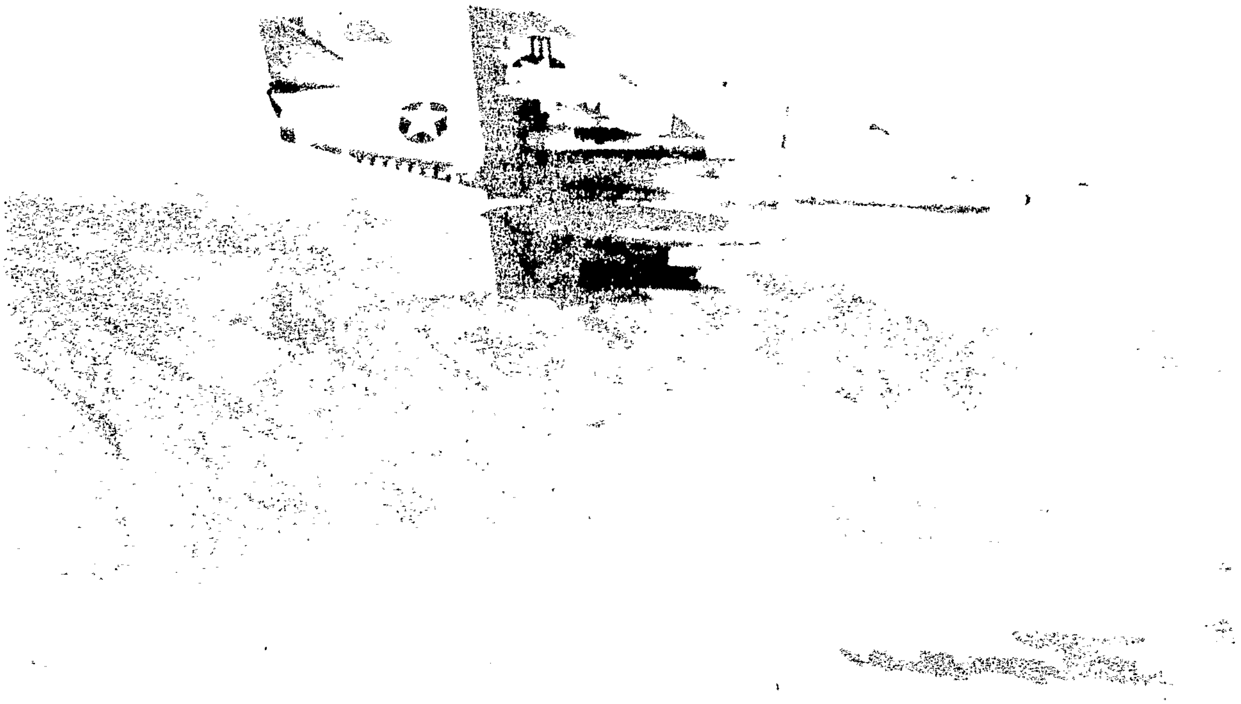


Figure 1

PRIME TARGETS FOR WALLEYE

FIXED, LARGE, STRONG STRUCTURES	● AIRFIELDS, PROTECTED FUEL TANKS, HANGARS AND RUNWAY ● PORT FACILITIES ● RAIL AND ROAD INTERSECTIONS ● BRIDGES OF ALL TYPES ● TUNNELS
FIXED, SMALL OR VULNERABLE TARGETS	● PARKED AIRCRAFT ● MAJOR GUN AND SAM INSTALLATIONS ● SUPPLY, FUEL AND AMMUNITION DUMPS ● RADAR INSTALLATIONS
SHIPPING	● LIGHTLY ARMORED COMBAT VESSELS ● MERCHANT SHIPS ● SMALL CRAFT

Figure 2

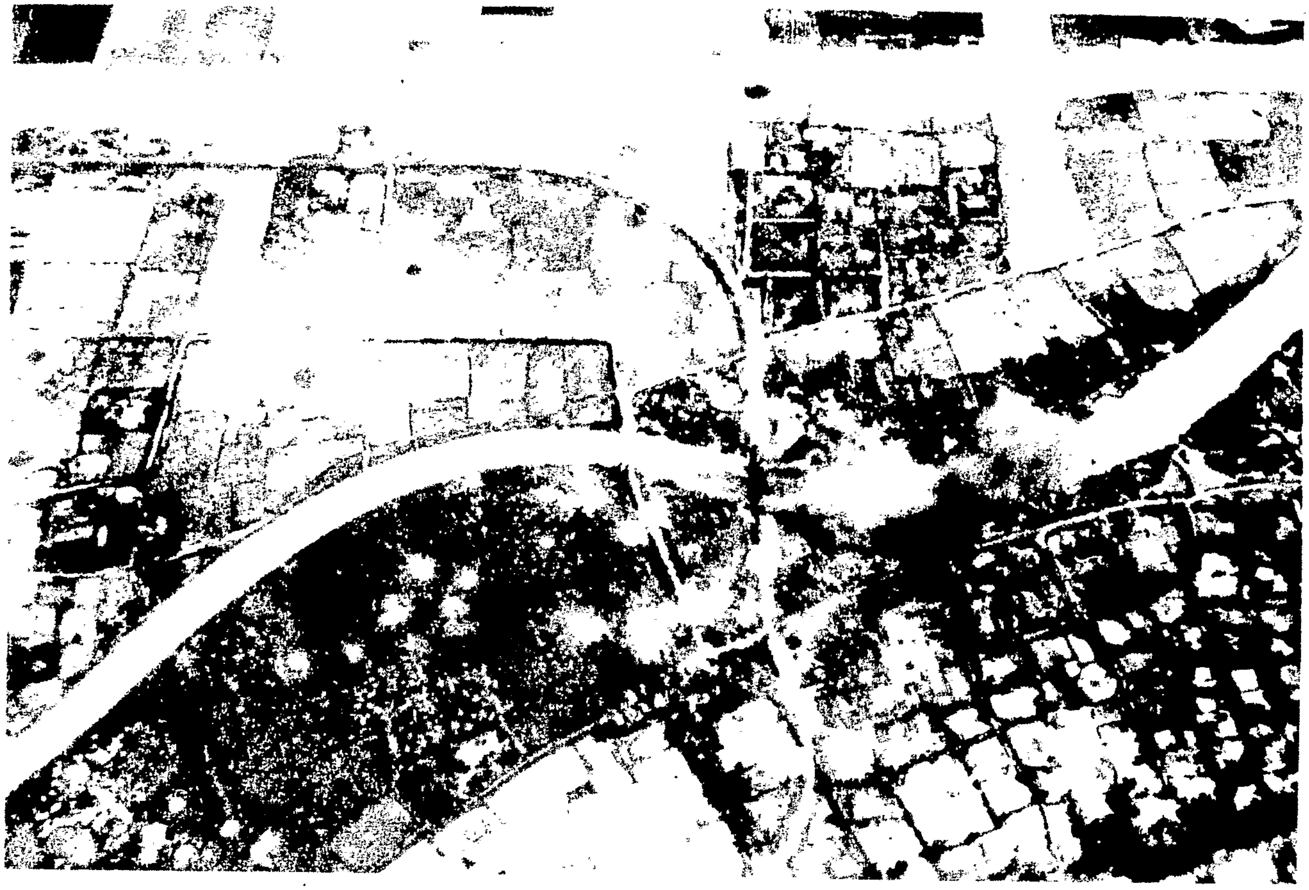


Figure 3

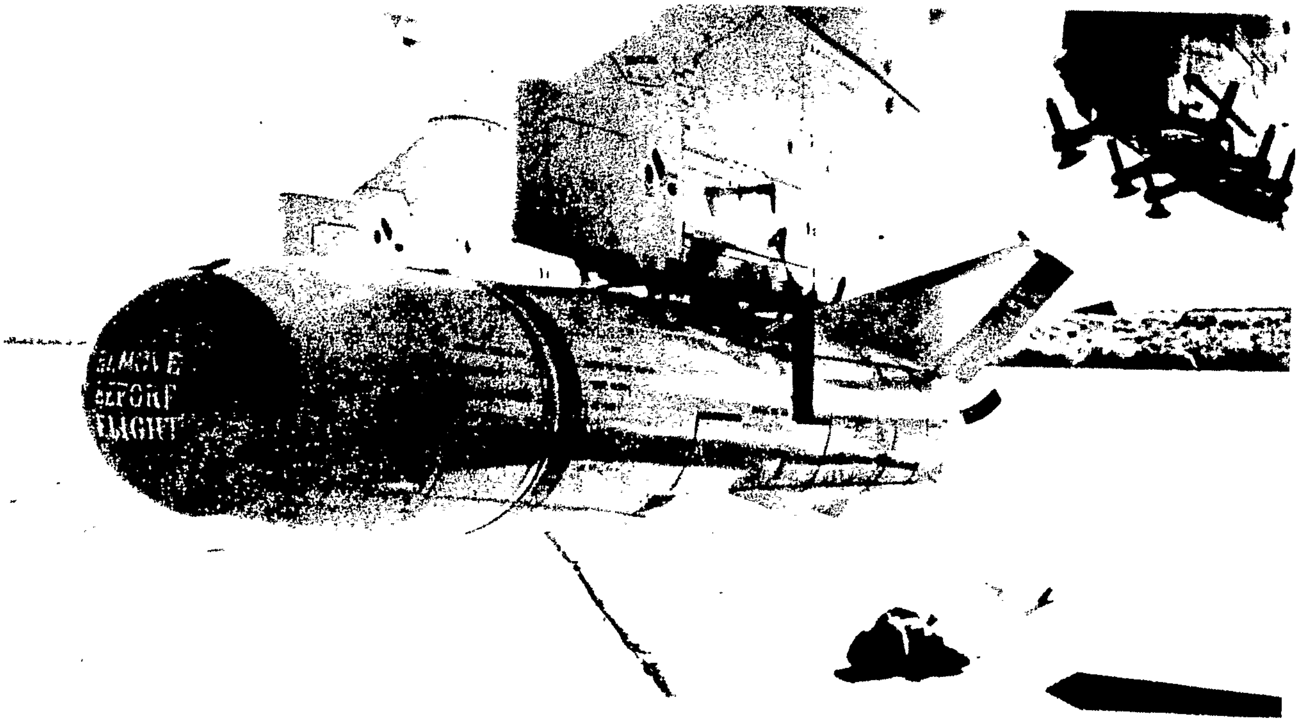

REMOVE
BEFORE
FLIGHT

Figure 4

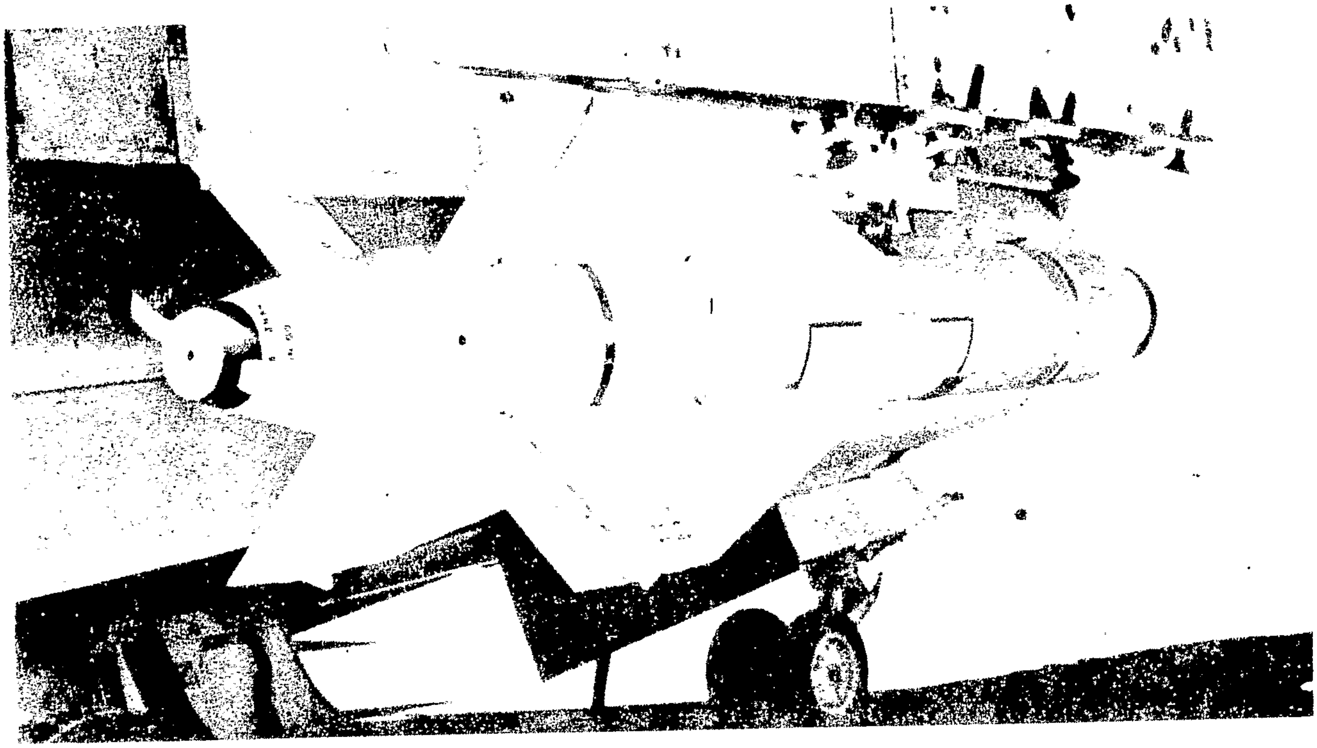


Figure 5

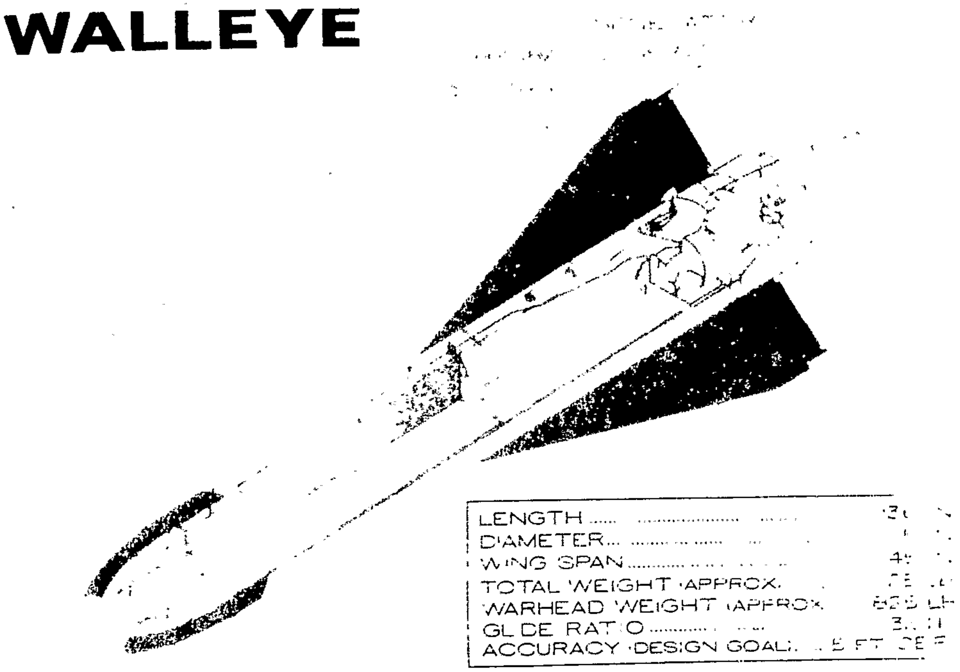

WALLEYE
LENGTH .... 3[illegible]
DIAMETER .... [illegible]
WING SPAN .... 4[illegible]
TOTAL WEIGHT (APPROX. [illegible]
WARHEAD WEIGHT (APPROX. 8[illegible] LB
GLIDE RATIO .... 3[illegible]
ACCURACY (DESIGN GOAL) [illegible] FT CEP

Figure 6

Walleye Operational Diagram

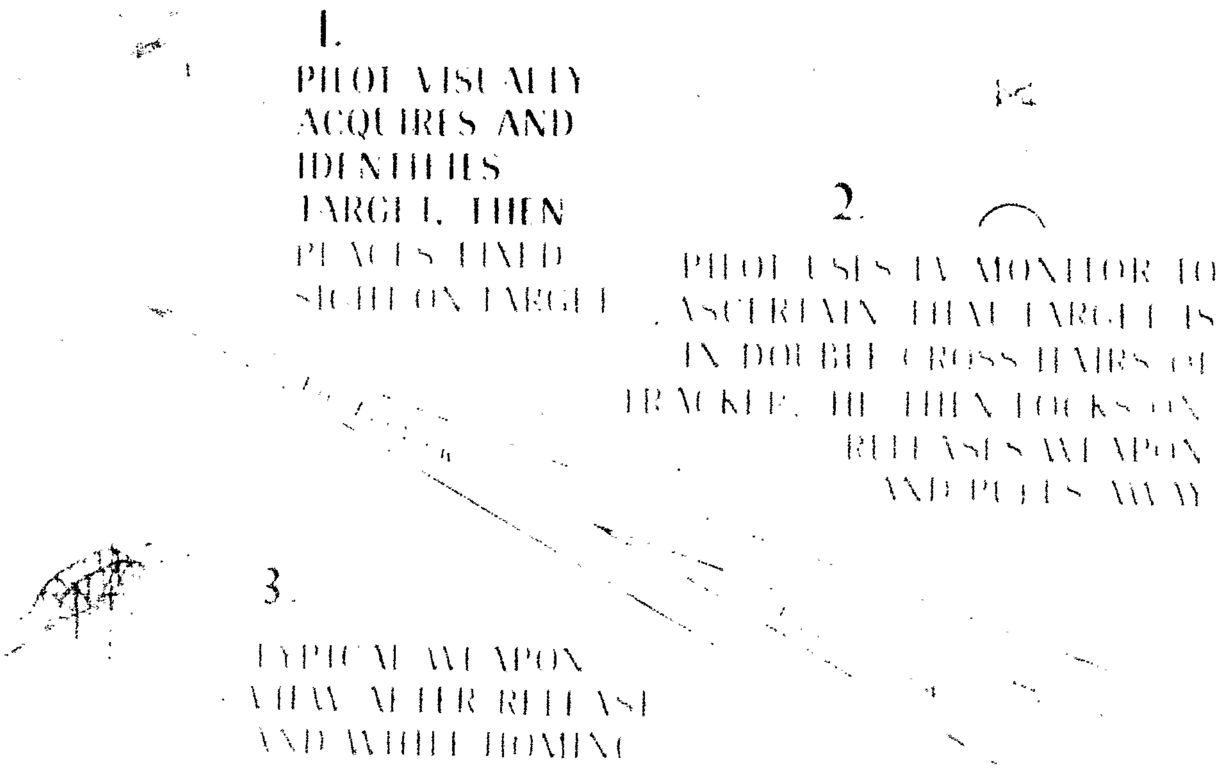
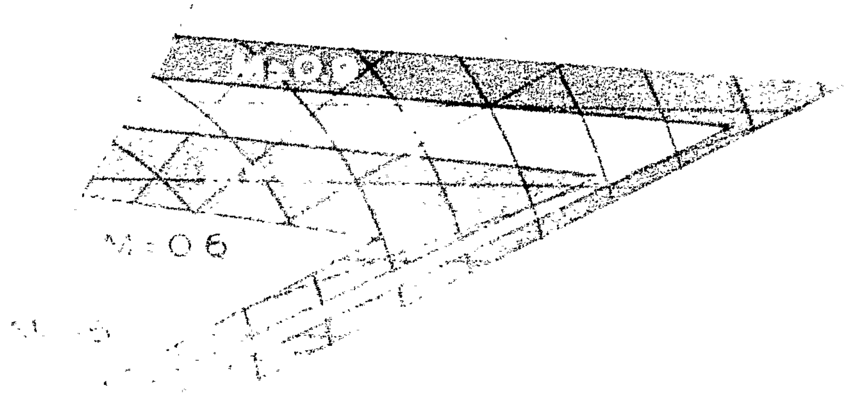

1.
PILOT VISUALLY ACQUIRES AND IDENTIFIES TARGET, THEN PLACES FIXED SIGHT ON TARGET
2.
PILOT USES TV MONITOR TO ASCERTAIN THAT TARGET IS IN DOUBLE CROSS HAIRS OF TRACKER. HE THEN LOCKS ON, RELEASES WEAPON AND PULLS AWAY
3.
TYPICAL WEAPON VIEW AFTER RELEASE AND WHILE HOMING

Figure 7



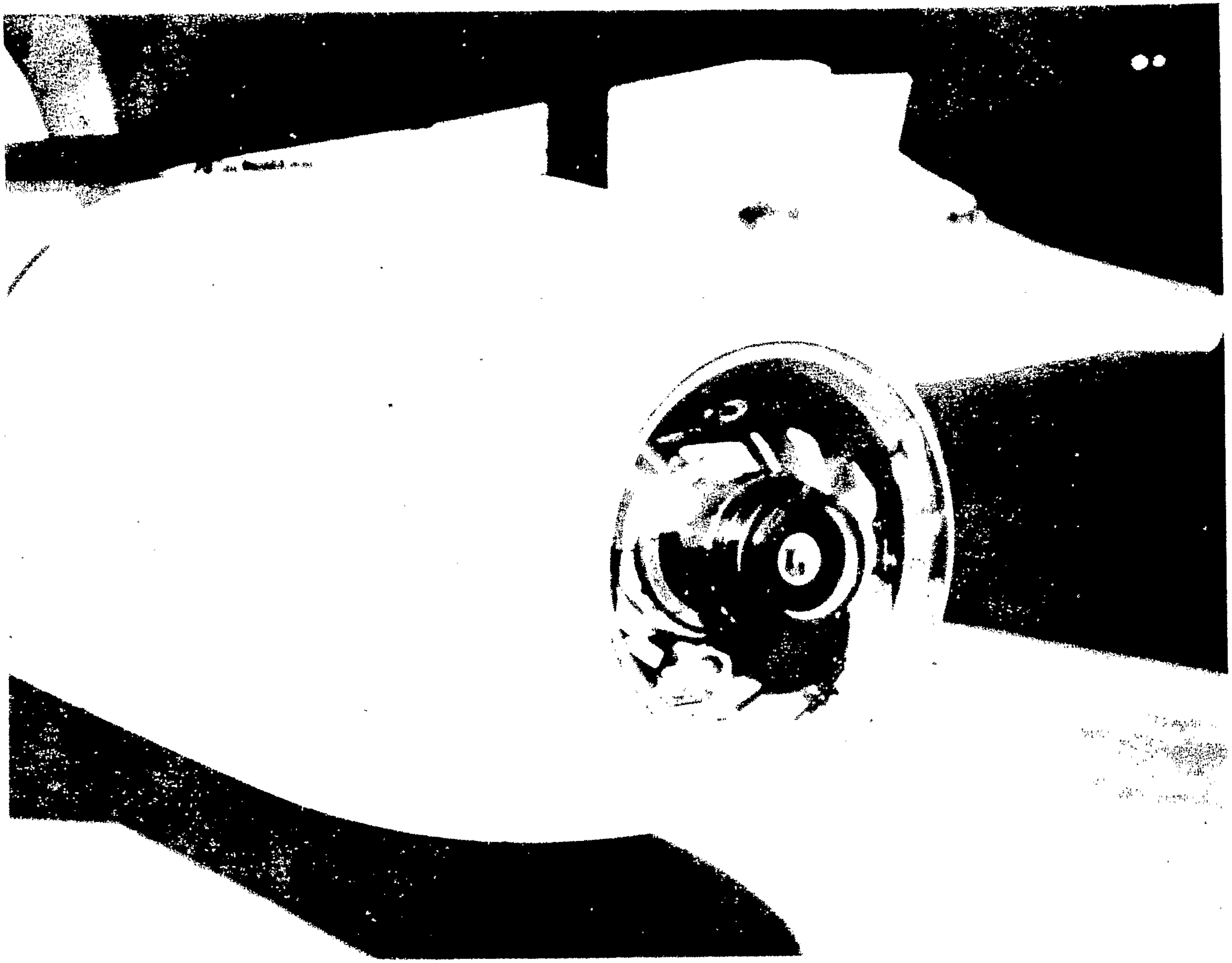


Figure 9

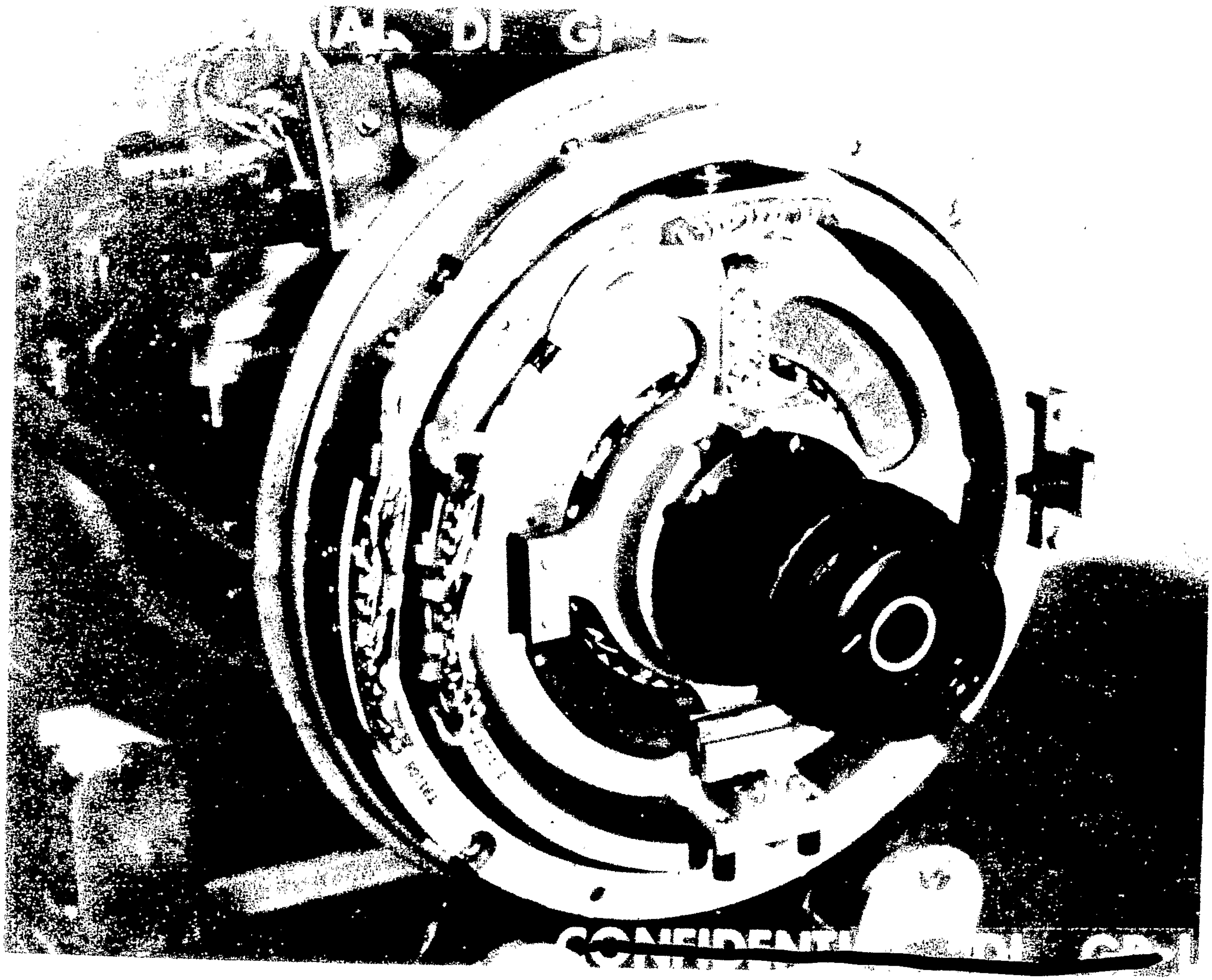


Figure 10

TRACKER CHARACTERISTICS FOR WALLEYE

CAMERA TUBE TYPE	ELECTROSTATIC VIDICON
FIELD OF VIEW	50 MILLIRADIANS
TRACKING GATES	3 MILLIRADIANS SQUARE
INTERLACE	2:1
LINES	525
FIELD RATE	60 PER SECOND
ASPECT RATIO	1.1
BANDWIDTH	5 mc
GIMBAL ANGULAR COVERAGE	30 DEG OFF AXIS IN ANY DIRECTION
PRECESSION RATE	± 4 DEG/SEC MAXIMUM
LIGHT RANGE	FULL SUNLIGHT TO 100 FOOT LAMBERTS AND TRACK A CONTRAST > 18%
LENS	8.75 IN. FOCAL LENGTH, f./4.5 CATADIOPTRIC
SPECTRAL FILTERING	DEEP RED OR NONE, PILOT OPTION

Figure 11

WALLEYE TRACKING RANGES

TARGETS	RANGE, MILES
SHIPS	
DESTROYER	15 TO 20
TANKER	20
BARGE	10
BRIDGES	
300' X 40' (4 PIERS)	6
60' X 20'	4
AIR BASE INSTALLATIONS	
HANGARS	20
RUNWAYS	8 TO 9
PARKED AIRCRAFT	4

Figure 12

15 IN. GUIDED MISSILE WARHEAD

Figure 13

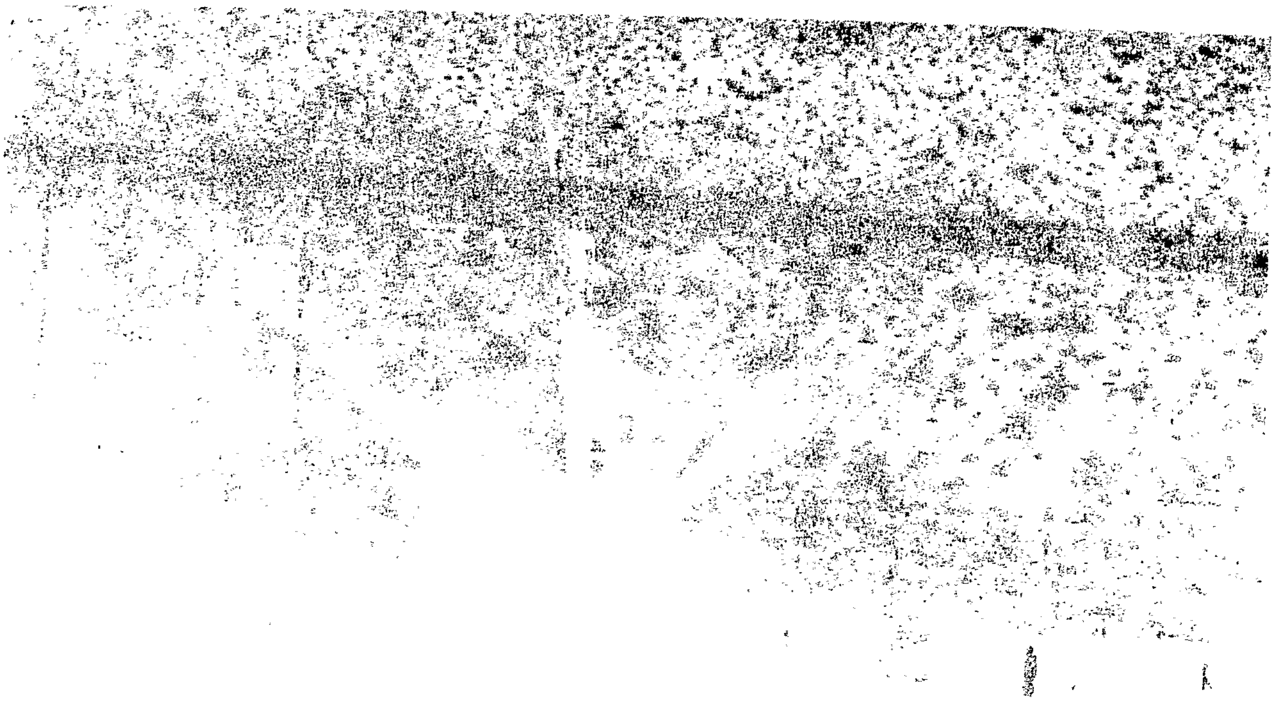


Figure 14

WALLEYE COMBAT RECORD
TO 27 MARCH 1969

	USN	USAF	TOTAL
EXPENDED	301*	129	430
WEAPON SUCCESS	271	114	385
HIT	206	74	280
% SUCCESS	90.0	88.4	89.2
% HIT	68.4	57.4	65.0

*73 ADDITIONAL USN ROUNDS EXPENDED ON WHICH ASSESSMENT OF RESULTS NOT YET RECEIVED.

Figure 15

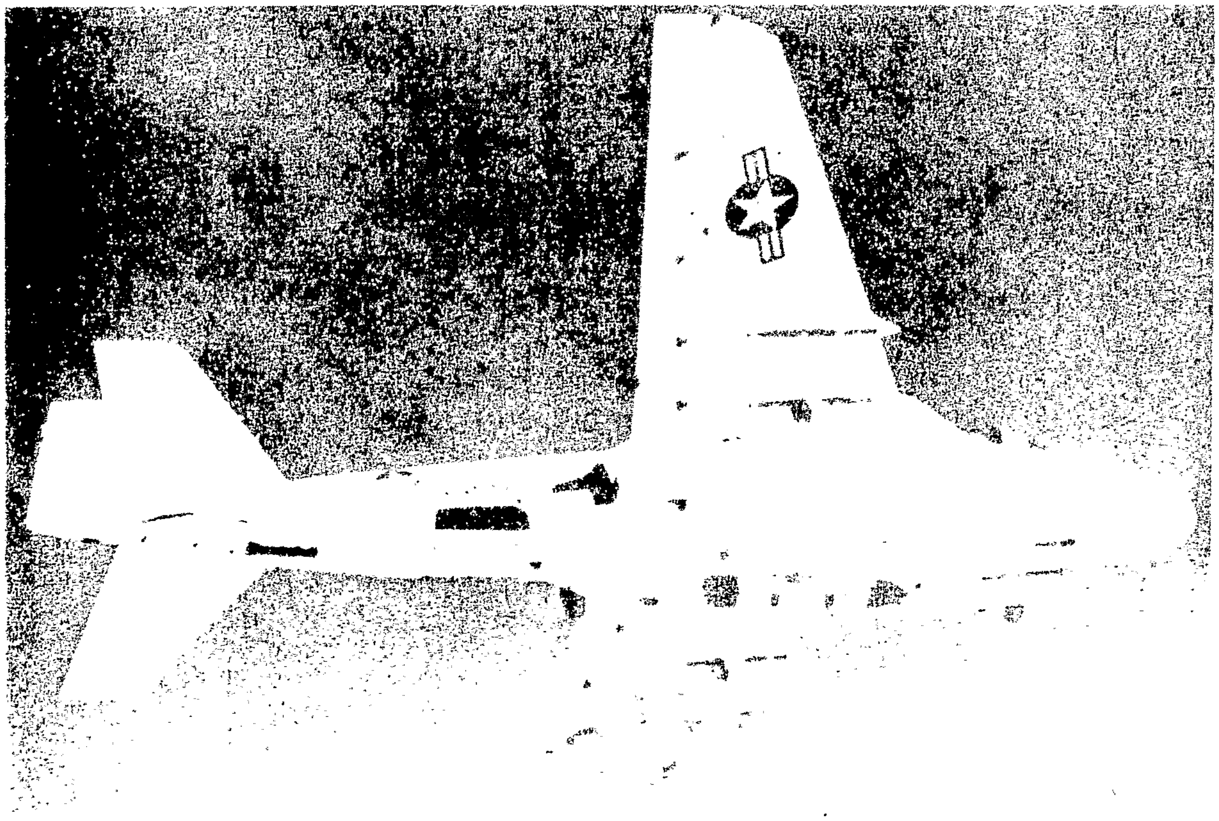


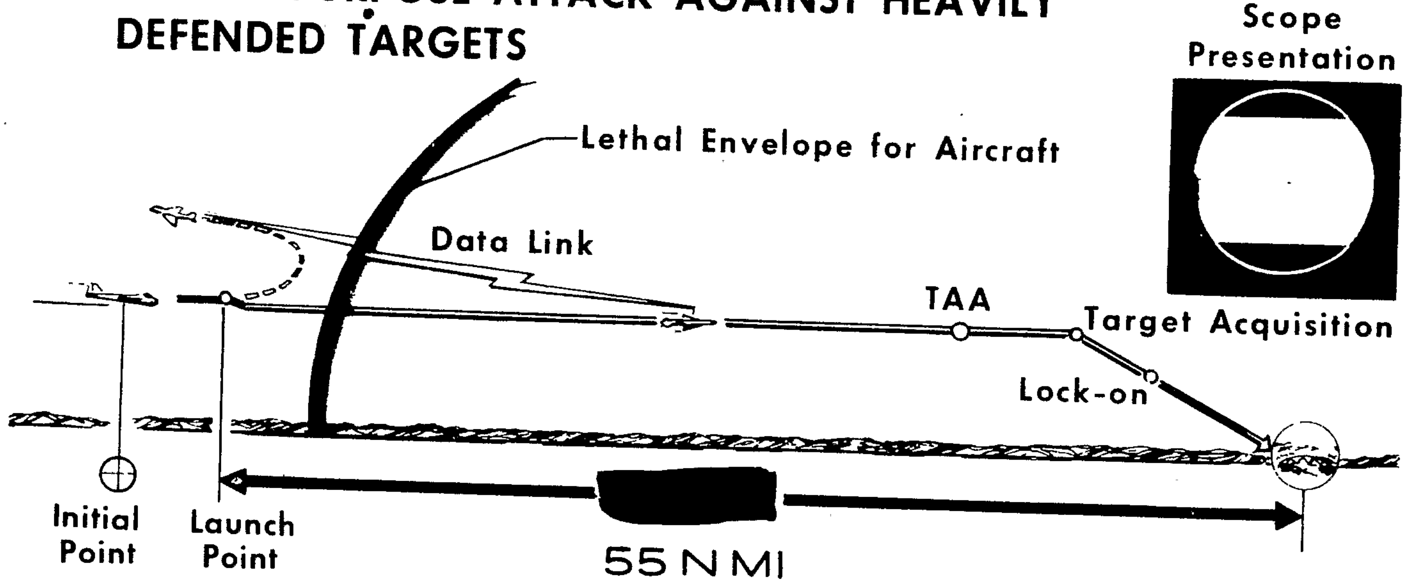
Figure 16

~~SECRET/RD~~

~~CONFIDENTIAL~~

CONDOR MISSION

GENERAL-PURPOSE ATTACK AGAINST HEAVILY DEFENDED TARGETS


Scope Presentation
Lethal Envelope for Aircraft
Data Link
TAA
Target Acquisition
Lock-on
Initial Point
Launch Point
[redacted]
55 N MI

REQUIREMENTS:

CEP - 10 FEET
RANGE - 55 N MI
WEIGHT - 2130 POUNDS
VELOCITY - HIGH SUBSONIC

WARHEAD - 630 POUNDS (HE)
GUIDANCE: ELECTRO-OPTICAL WALLEYE
AIRCRAFT COMPATIBILITY - A-6A,
COMPATIBLE WITH A-7

PG 102956

~~CONFIDENTIAL~~

Figure 17

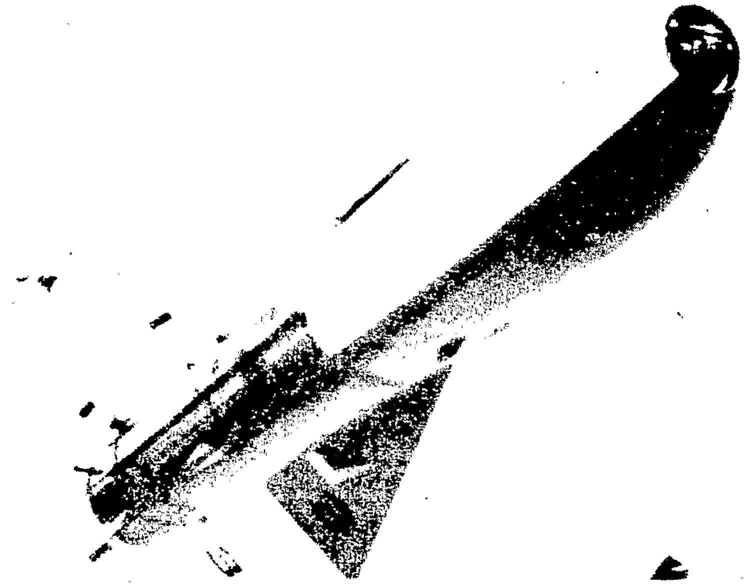
~~SECRET/RD~~

~~CONFIDENTIAL~~

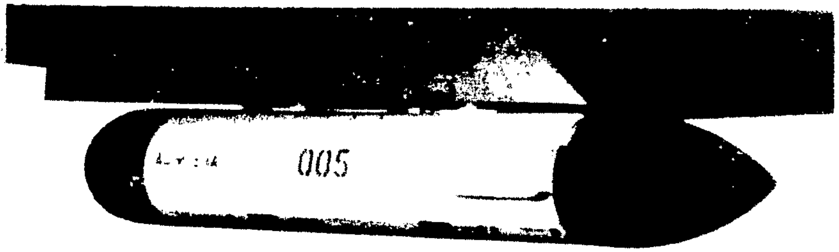
~~SECRET/RD~~

CONDOR WEAPON SYSTEM

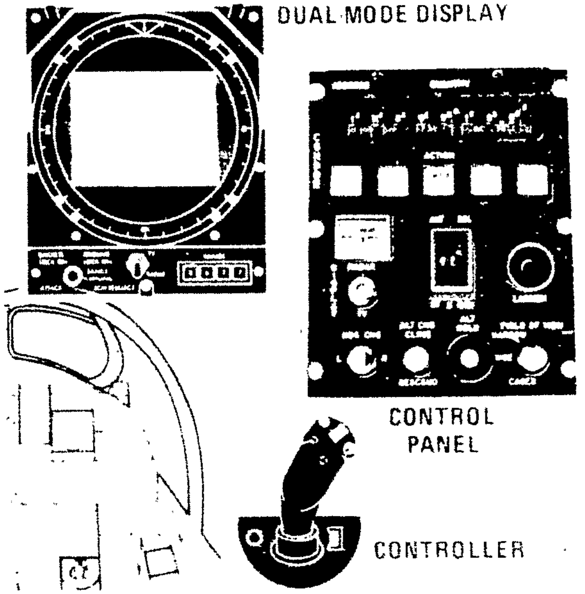
MISSILE

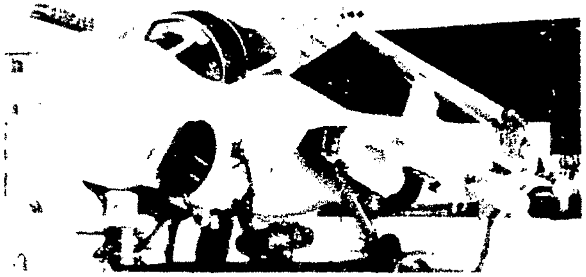


POD



AIRCRAFT INSTALLATION


DUAL MODE DISPLAY
CONTROL PANEL
CONTROLLER



~~CONFIDENTIAL~~

~~SECRET~~

LENGTH	166 INCHES
DIAMETER	17 INCHES
WING SPAN	53 INCHES
LAUNCH WEIGHT	2130 POUNDS
WARHEAD WEIGHT	630 POUNDS

GUIDED MISSILE

Figure 19

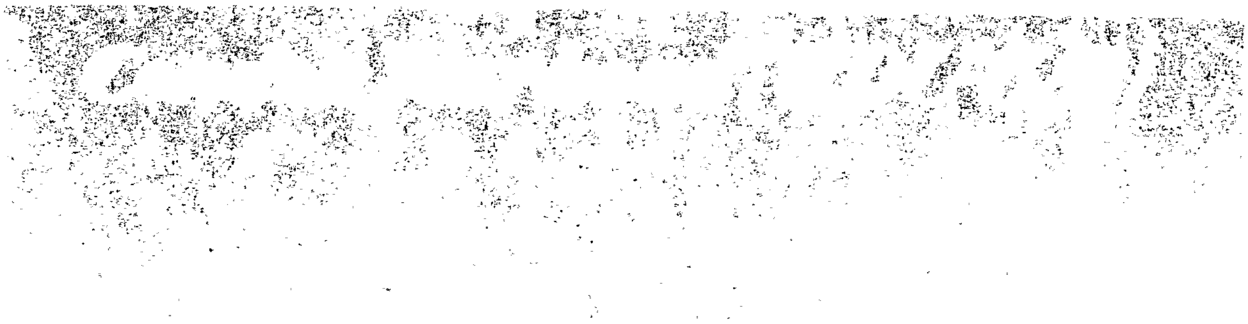
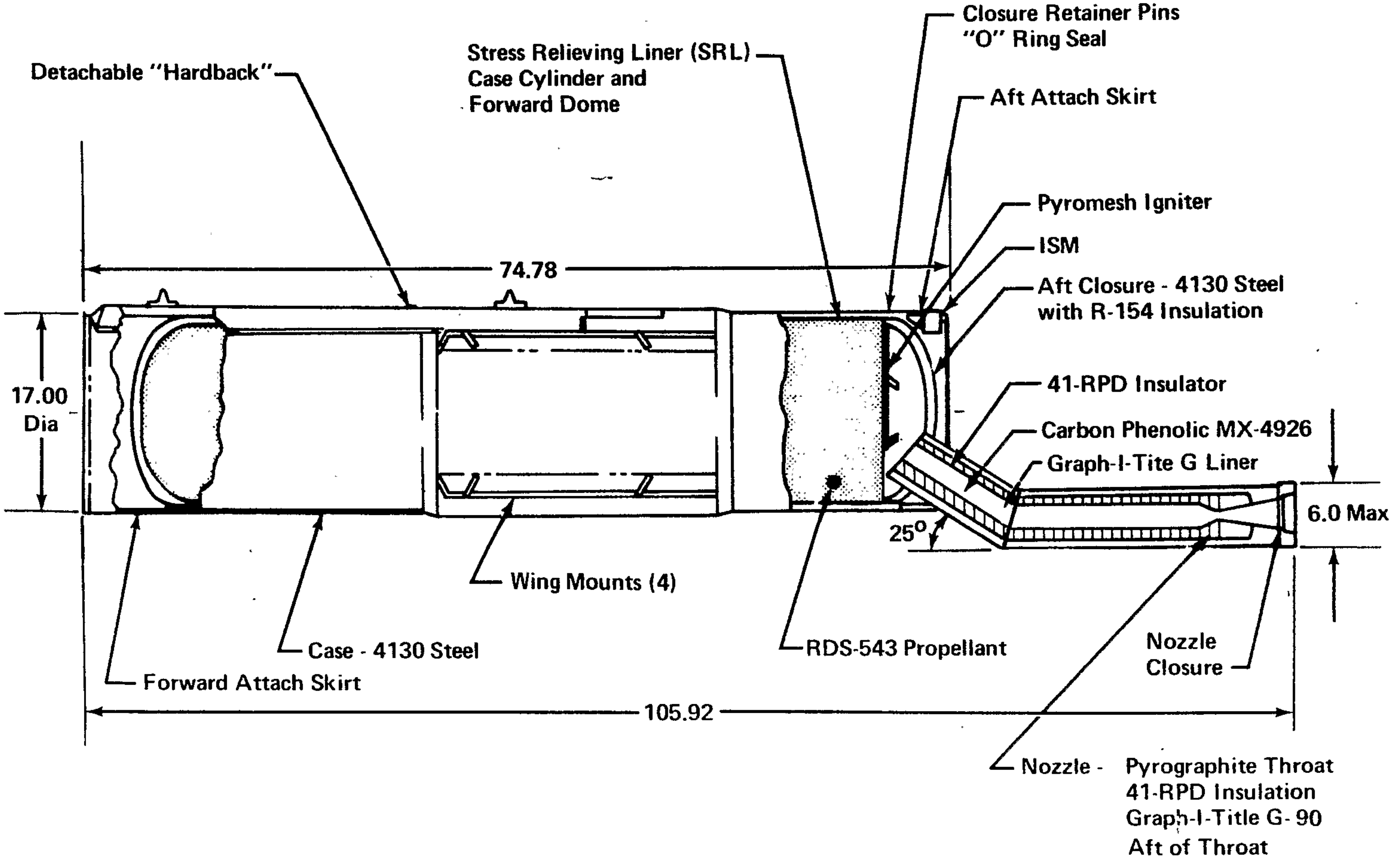


Figure 20

SOLID ROCKET MOTOR


Detachable "Hardback"
Stress Relieving Liner (SRL) Case Cylinder and Forward Dome
Closure Retainer Pins "O" Ring Seal
Aft Attach Skirt
Pyromesh Igniter
ISM
Aft Closure - 4130 Steel with R-154 Insulation
41-RPD Insulator
Carbon Phenolic MX-4926
Graph-I-Tite G Liner
74.78
17.00 Dia
6.0 Max
25°
Wing Mounts (4)
Case - 4130 Steel
Forward Attach Skirt
RDS-543 Propellant
Nozzle Closure
105.92
Nozzle - Pyrographite Throat 41-RPD Insulation Graph-I-Title G-90 Aft of Throat

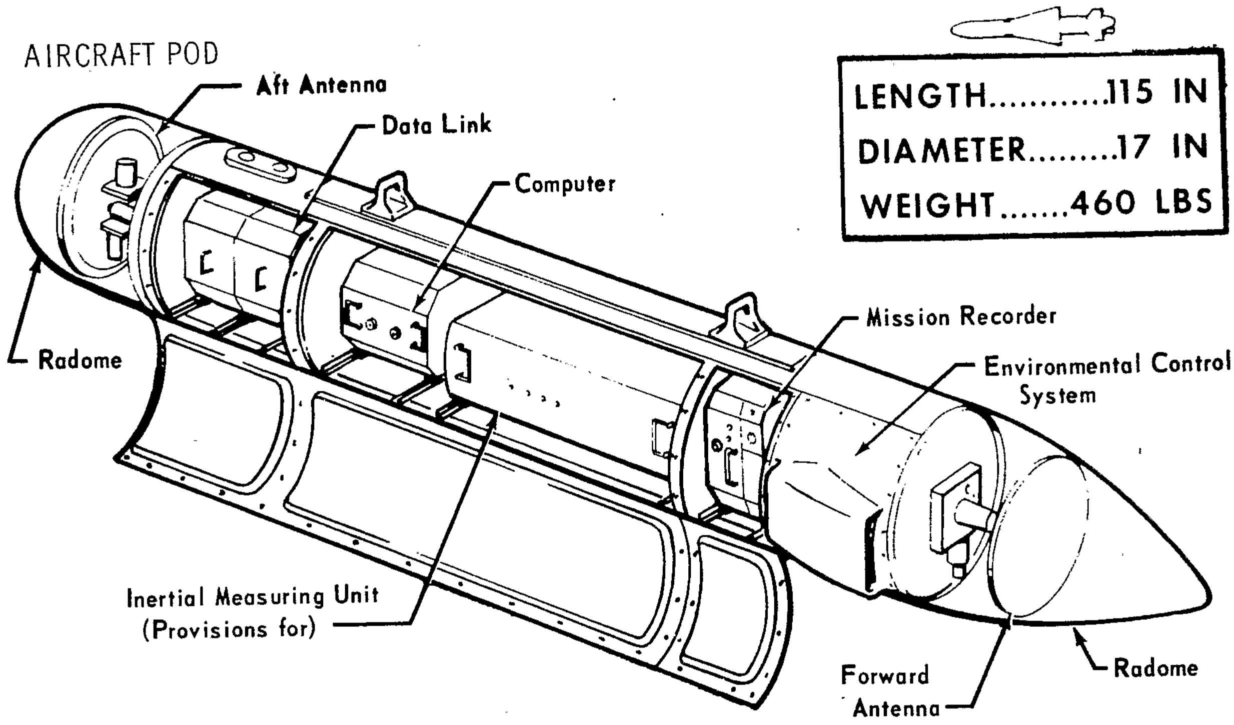
PG 104587

~~CONFIDENTIAL~~

Figure 21

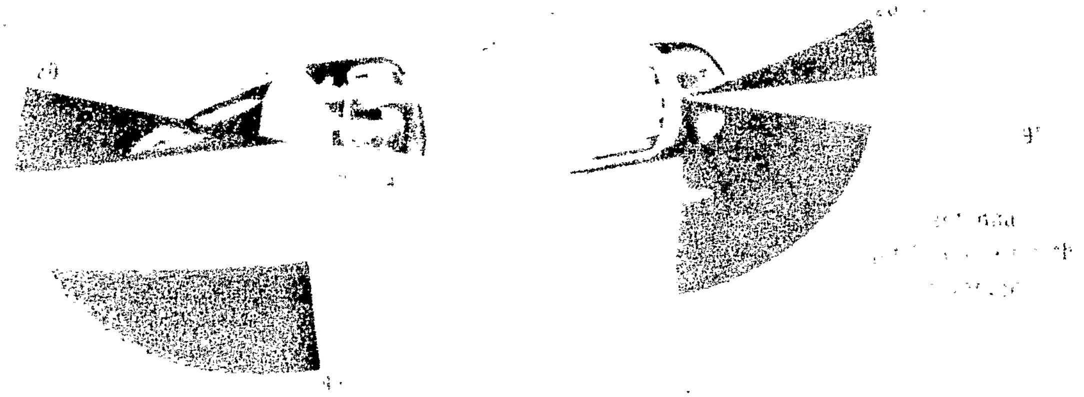
CONDOR
GC 2
4
2
CONFIDENTIAL
CONFIDENTIAL

Figure 22


AIRCRAFT POD
Aft Antenna
Data Link
Computer
Radome
Mission Recorder
Environmental Control System
Inertial Measuring Unit (Provisions for)
Forward Antenna
Radome

LENGTH............115 IN
DIAMETER.........17 IN
WEIGHT.......460 LBS

Figure 23



- **PLANAR ARRAY, FULL TRACKING**
- **GAIN**
  - **32 db - TRACKING MODE**
  - **16.5 db - ACQUISITION MODE**
- **BEAMWIDTH - VERTICAL AND HORIZONTAL**
  - **4.2° TRACKING**
  - **27° ACQUISITION**
- **TRACKING ACCURACY - ≲ 0.15°**

Figure 24

MISSION SEQUENCE

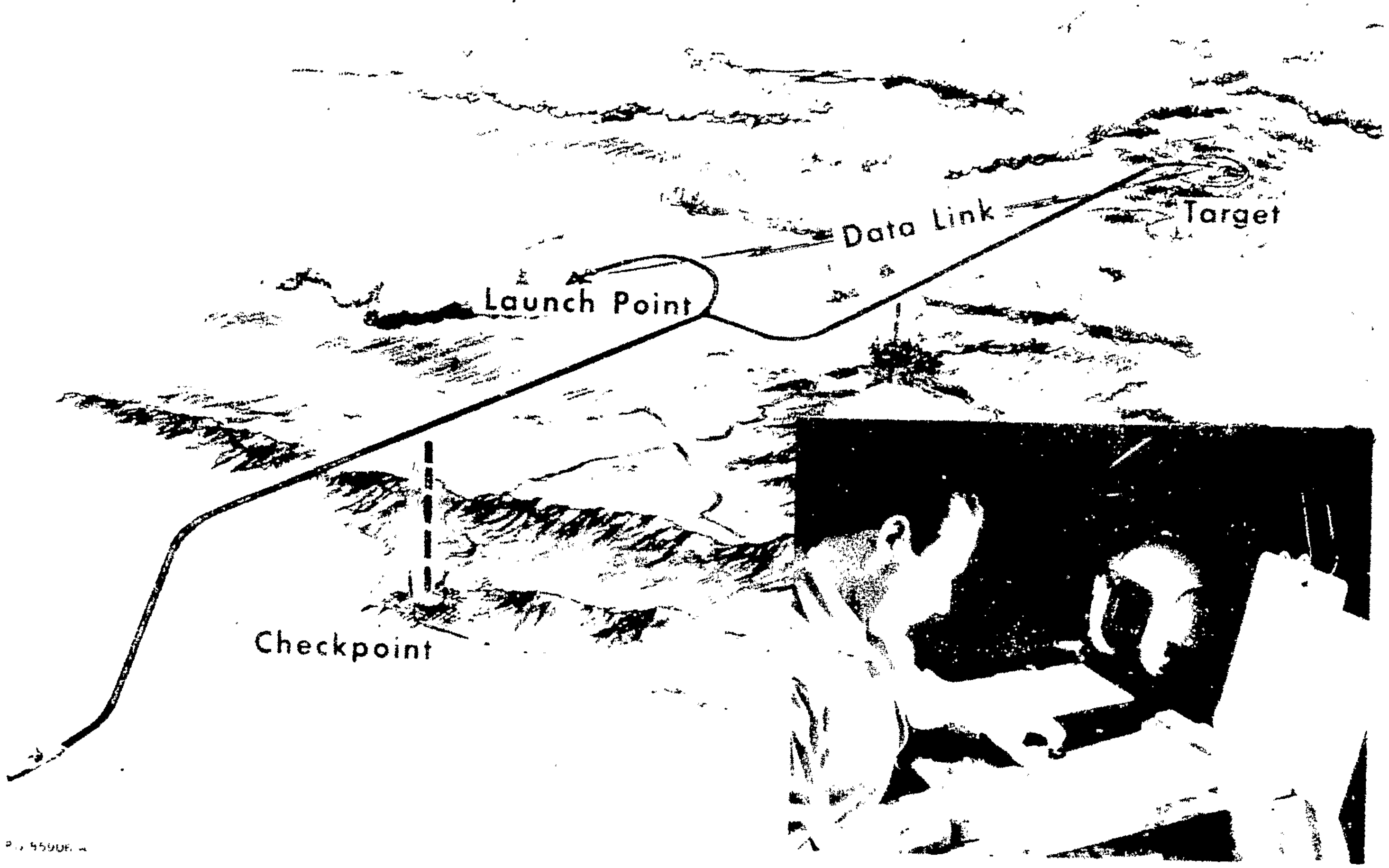
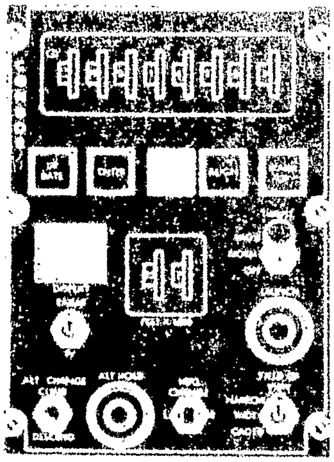

Target
Data Link
Launch Point
Checkpoint

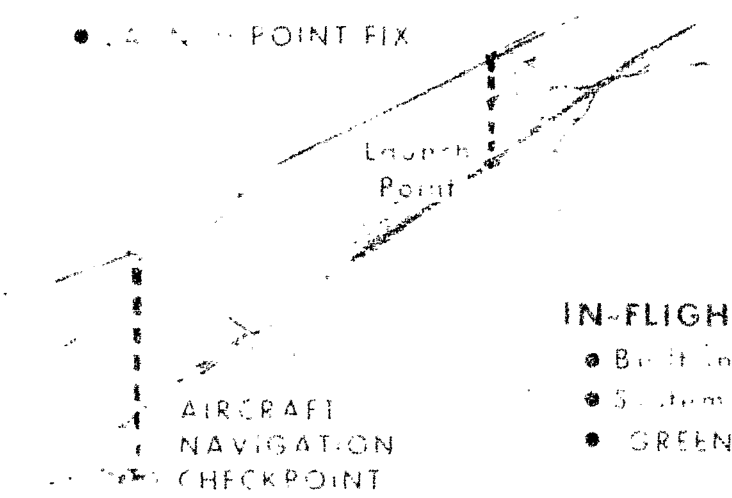
Figure 25

[redacted]

NAVIGATION TO LAUNCH

- IN FLIGHT SYSTEM CHECKS
- COMPUTER SETUP
- LAUNCH PREPARATION
- LAUNCH POINT FIX

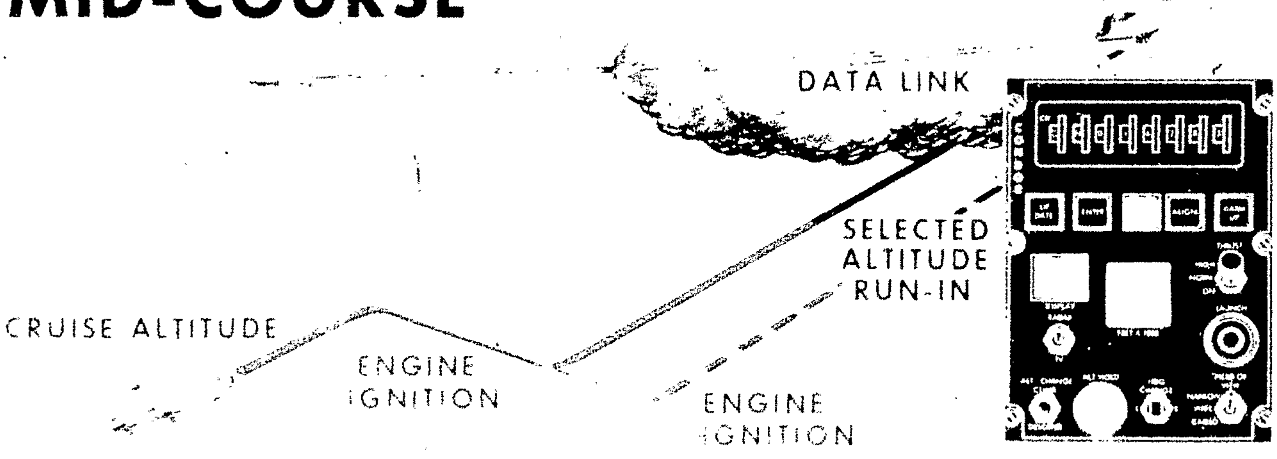



Launch Point
AIRCRAFT NAVIGATION CHECKPOINT

IN-FLIGHT CHECKS

- Built in Test Performed
- System Energized
- GREEN LIGHT SYSTEM READY

MID-COURSE


DATA LINK
SELECTED ALTITUDE RUN-IN
CRUISE ALTITUDE
ENGINE IGNITION
ENGINE IGNITION

AIRCRAFT LAUNCH & LEAVE

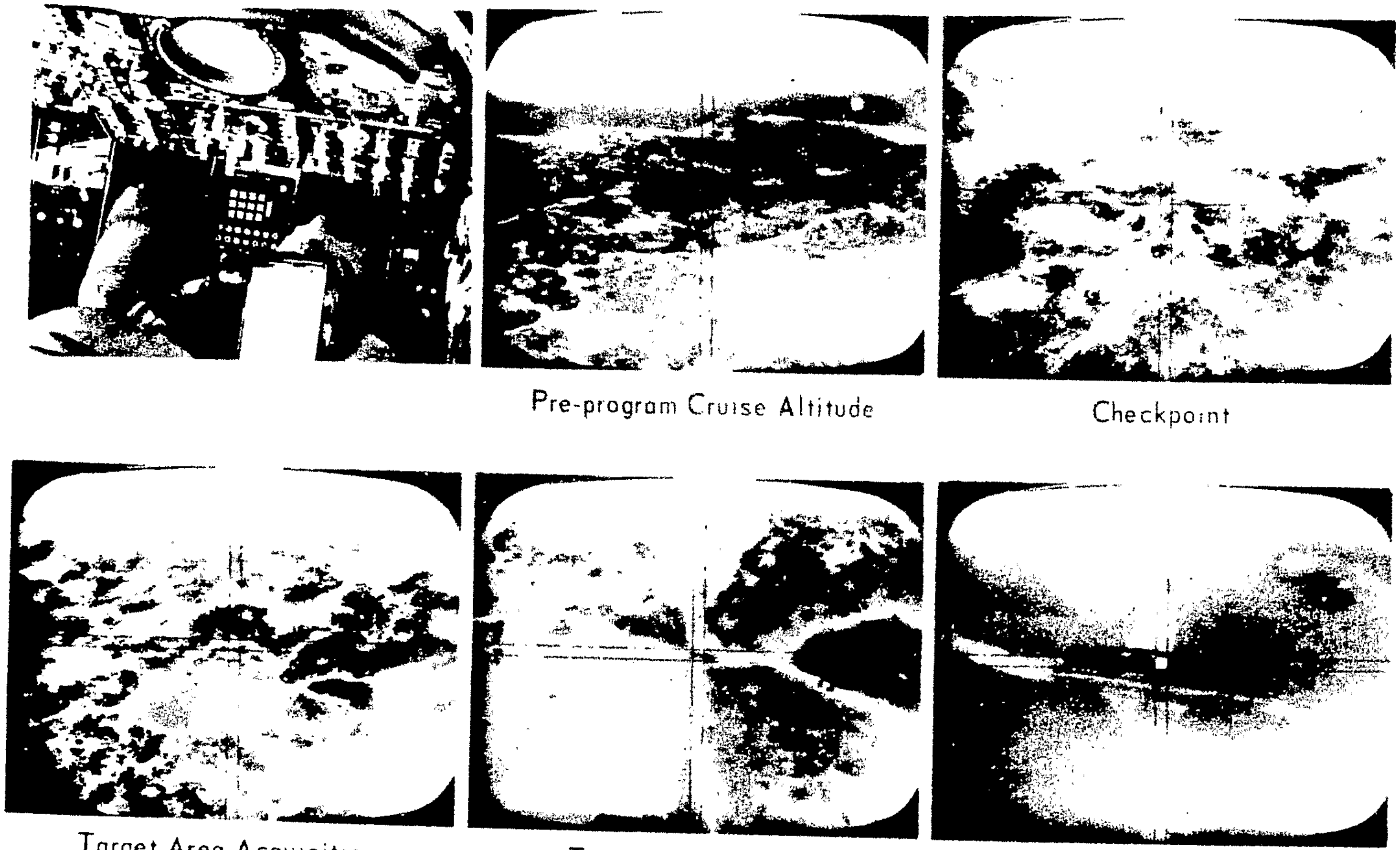
DATA LINK Tracking Initiated
Missile Continues Descent to
CRUISE ALTITUDE

ENGINE IGNITION at CRUISE ALTITUDE
Operator Uncages Seeker and
Establishes Orientation

Figure 27

[redacted]

TARGET ACQUISITION AND LOCK-ON



Pre-program Cruise Altitude

Checkpoint

Target Area Acquisition

Target Acquisition

LOCK-ON

PG 85911B

Figure 28

UNIQUE QUALITIES OF CONDOR

- FOR THE FIRST TIME IN AIR-LAUNCHED ORDNANCE HISTORY THE FLIGHT PATH REQUIREMENTS OF THE AIRCRAFT ARE DIVORCED FROM THE FLIGHT PATH OF THE MISSILE.
    - Tactical Freedom in Selecting Approach to Target
    - Missile Maneuvering After Launch
    - Operator Functions Separate from Pilot Functions
    - Aircraft Maneuvering Independent
- INFORMATION FROM MISSILE AND COMMANDS TO THE MISSILE PROVIDED UP TO IMPACT
    - Real Time Reconnaissance
    - Strike Assessment
    - Aimpoint Selection and Correction

Figure 29

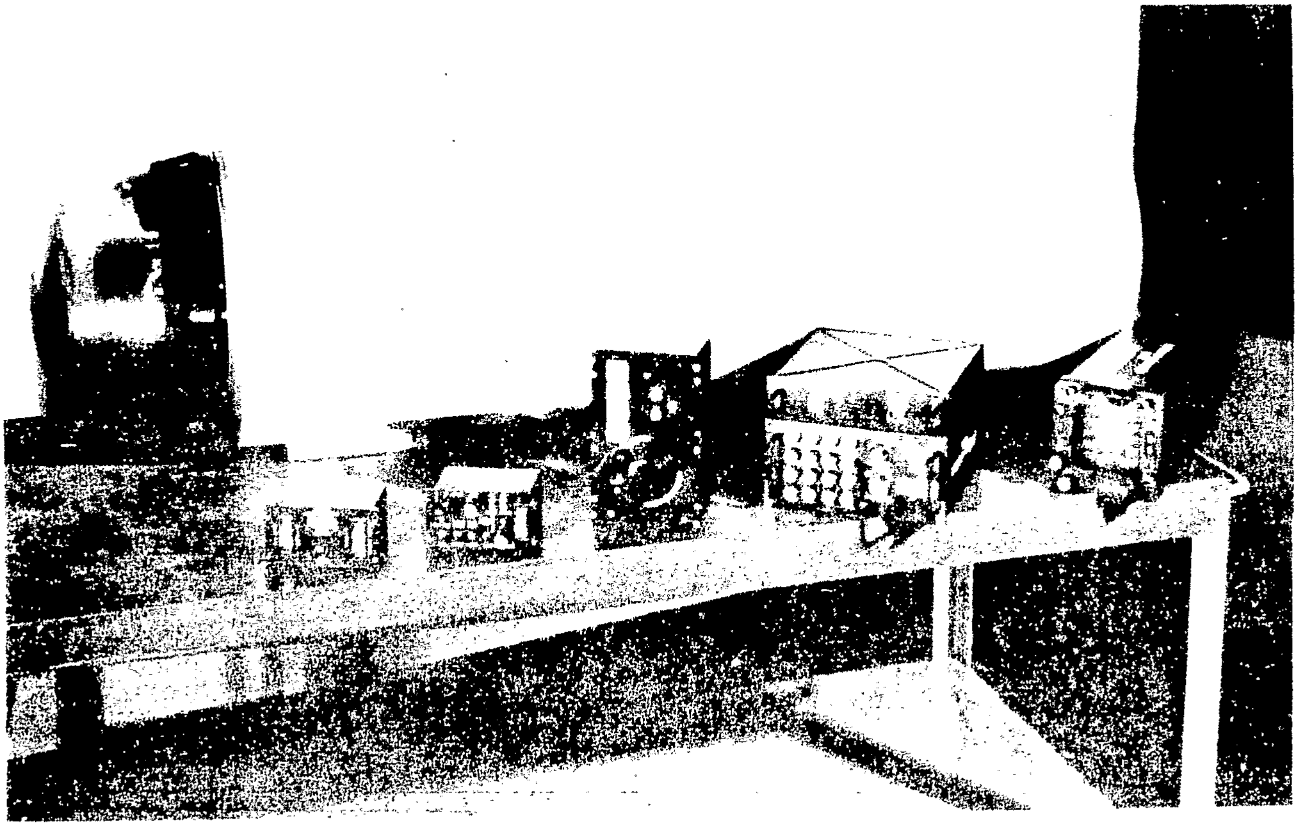


Figure 30

Question and Answer Period

LANDAUER (LRL): What is the vulnerability of Walleye after it's launched? And does that account for some of the unsuccessful flights?

CRAWFORD: No, we have no reports of any missiles having been hit after launch. I know of one missile that was hit on the airplane but that's the only case we had. The missile potentially could be shot down, since it flies in a modest high subsonic region; but in general we think that the aircraft itself is a much more profitable target than the missile. The missile is quite small; we have at home some films taken from the target of a missile approaching, and you just don't see anything at all until the last couple of seconds and then bang, it's there. And so optical systems won't do it; it would have to be a radar-directed system.

McDONALD (LRL): What about the jamming problems of Condor and Condor-like systems after they've actually been launched from the aircraft?

CRAWFORD: That's a good question. Certainly they can be jammed; no question that you can't make a data link system which is good enough to be completely immune to jamming. The present system is relatively unsophisticated; it was made that way deliberately because we wanted to keep the complexity and the cost low in initial versions, and our indications are that the jamming capability is not presently there on the Soviet side. They could certainly build jammers. There are several things that work against the jammer, however. One is the fact that the beam width on the antennas is fairly narrow. The beam width on the pod antenna is 4.2 degrees. So his jammer has to be located within a fairly narrow region to be able to jam the system. Furthermore, there are 10 channels available to operate the system on. As a result he's got to determine which channel you're on before he can jam you. That means he's got to pick up the transmission, and if he picks up the transmission from the aircraft that's not the same frequency as the transmission from the missile. Likewise if the picks up the missile, it's not the same frequency as the transmission from the aircraft; so if he's using a directional jammer—which he pretty much has to do in order to get enough power into you—then he's got to pick up the signal, say, from the missile and then jam in the aircraft direction with that signal. So he has a substantial problem. In addition, if the launch aircraft descends below radar horizon for the target area, then a jammer located in the target area can't get into the receiver in the aircraft, but the aircraft can still communicate to the missile because it's up in the air and above radar horizon. So there are several ways to play this. Eventually, if jammers were developed that were bad enough we'd have to go to a sophisticated coding scheme to try to beat them.

DOUGHERTY (SLA): I don't think you told where the pilot was driving from in that last Walleye sequence. Can you tell us what the capabilities are on the remote control?

CRAWFORD: Some of those have been run from a ground van but more recently it's from a second A4. We have the missile captive on one A4 making the test run; the operator follows on a TA4 at a range of some 10 to 20 miles, and he does the controlling after the pilot in the aircraft with the missile initially locks it on the target.

BYERS (R&D, Dept. of AF): In your combat experience statistics on Walleye, you've given its success and hit probabilities which do not reflect the accomplishment of the mission; I wonder if you also have probabilities for successfully demolishing the bridge, or whatever the target is, in one round.

CRAWFORD: I don't have the figures with me on that. It has depended rather strongly on the target itself. On some of the targets, particularly the harder bridges, we've hit them, but they have not been dropped. On the softer bridges, we have dropped them. I don't know what the percentage is there. In that connection there's been a request for a larger version of Walleye, and Walleye II is currently under design. It's basically the same as the existing missile; in fact it uses the same guidance and control sections. It looks quite a lot like the basic bird except for the bigger warhead section; we're up over 1000 pounds of explosive now, and the overall weight of the missile is 2300 pounds.

KING (AFXPD): I must challenge you on the point about uniqueness. Condor is not the first air launch missile which has a flight path independent of the aircraft. Maybe the first tactical, but not the first air launch missile. We've had a number of them operating on strategic aircraft for years. The question I really have concerns the range of your data link equipment and the relative position between aircraft and target from a long range release. If you use your advertised range of some 55 miles from a high altitude launch and turn your aircraft around and get out, it looks as if you're going to be up against the outer limits of your so-called 100-mile range data link. Is that not true?

CRAWFORD: Right. The 100 miles was selected on the basis of being able to turn 180 degrees and retreat from the target area, and we do reach approximately 100 miles at that point. Now that won't be true if you're running a supersonic aircraft but we're not on any supersonic aircraft.

COTTER (SLA): You said that there's an interest in our larger yield Walleye, and at the same time it looks as if we're cutting down the yield of the Condor. This doesn't seem to be too sensible. That's an observation.

CRAWFORD: Yes, you've touched a point that's been commented on by many people before. We'd like to have a bigger warhead in Condor; in fact we've got some versions designed where if you're willing to trade some range you can get more warhead; but if you need the range and you're constrained to the missile size that we presently have, then you have to put in a certain amount of propulsion and the remainder is the warhead. When the studies were initially made on this system, everyone was saying 500 pounds is enough to kill any target we are going to have. In fact they were criticizing Walleye as being too big a warhead. We now realize that's not right. The one thing we have in our favor is being able to update the aimpoint. We're quite sure that, in some of the cases where Walleye has not killed the target, it could have if we had refined the aim to a more vulnerable point on the target. Condor can do that. That makes up for the warhead a little bit.

COTTER: Is that true for heavy bridges?

CRAWFORD: Heavy bridges will be the worst case, of course, and you're probably still stuck there, but refining aim still helps. You may have to put in two or three missiles instead of just one.

COTTER: Perhaps you're not the right person to answer this question, but I would be interested in observation or comment from the audience. Why hasn't the Navy established a requirement for the nuclear Walleye?

CRAWFORD: I think I have to pass on that one.

AGNEW (LASL): Would Captain Whiteaker like to answer that?

WHITEAKER (Office of CNO): I might just say that the JCS has established a requirement for the nuclear Walleye. I think that is sufficient.

GARWIN (IBM): Does Condor in fact have an inflight destruct, command-destruct?

CRAWFORD: It does not presently have it; the contractor has been requested to provide an ECP on this because CNO has requested that that be added to the system. It's quite easy to provide because there are spare channels in the data link. It's just a matter of hooking them up.

AGNEW: Is it possible to have the pod or the control in a separate airplane and then send out other aircraft which have not been modified—just drop things in some sort of glide basket and then control them from another aircraft?

CRAWFORD: Yes, you certainly could. We've even looked at things like putting the control pod on the ground and launching the missiles from the airplane. There are a lot of ways you can play that game, and it's just a matter of whether anybody is interested in the usability of that sort of thing.

AGNEW: That would really make it hard to jam.

CRAWFORD: Yes.

MANEY (ASD/AF): I would like to ask if you have any idea what the unit cost of this system is?

CRAWFORD: Yes, it's too high.

MANEY: In particular you said for certain hard bridges it might take two or three to knock them down; so I'm asking how much it costs to kill a bridge of this sort.

CRAWFORD: The best figure I could give you at the moment is that the missile is in the vicinity of $100,000. It's strongly dependent on how you contract for them and how many you buy. If we follow present plans, we're currently set up to buy about 2000 missiles in a series of relatively small buys over a period of 5 years. From a budgeting standpoint this is a nice way of doing it because you don't have to commit a large number of dollars at any one point, but it's a very inefficient way of buying the missiles. Also there are a number of features in the system which are really more expensive than they should be. For instance Walleye costs on the order of $15,000 and there's a big difference between that and $100,000. We're working now to apply the advanced Walleye technology to Condor to try to reduce this cost, and I would expect with some reasonable engineering the cost will come down to perhaps half the present figure.

Richard L. Garwin
IBM

THE IMPACT OF TACTICAL COMMUNICATIONS AND NAVIGATION SYSTEMS ON MISSILES, BOMBS, AND ARTILLERY OF THE FUTURE

First of all, I'd like to agree with the assessment by General Burchinal and the comments by General Cowan and General Yudkin on the changing balance and the changing context of the use of tactical nuclear weapons. I recognize the importance of the general trend and the emphasis on accurate delivery means. I welcome such evaluations of our present capability because I think it is vital to know our present as well as potential capability. Too often one has to deduce the present from the improvement which is claimed when one signs the contract for a new weapon system. But it's not sufficient for each person just to do his best. Beyond that we have to know what our capability is at any time. We have to know, if we start a war, whether we're sure to win, whether we have some chance of winning, or whether we have no chance at all. In general we have to know what is the range of consequences of any of our actions. One conclusion of these assessments, it seems to me, is the extreme vulnerability of our basing posture, of our theater nuclear forces in Europe not only to nuclear attack but to conventional attack. In addition, people have noted the asymmetry in the air defense postures of the Warsaw Pact and the NATO forces, the asymmetry in our vulnerability to sabotage.

So while I agree with the assessment that things are pretty bad on balance, I doubt that the relatively minor "fixers" that have been proposed will in fact improve our relative status over the years as the Warsaw Pact also improves. Our present posture, it seems to me, is tied to long runways and to main operating bases in Europe. It's highly vulnerable to destruction and pindown with runway cratering devices, with nuclear weapons, or with nerve gas attacks delivered by aircraft or by rockets.

In the tactical conventional role, as opposed to nuclear, against moderate defenses, we are dependent on large numbers of support aircraft, jammers, migcap defense suppression, and rescue, as our experience in Vietnam shows. In fact there have been periods of a month or more during which 4 strike aircraft were accompanied by 12 or 16 support aircraft, each of which had some vulnerability of its own. Further, we have an extensive force with a long replacement and training time. If one has an average attrition of 1/2%, or 1%, or 2%, it takes a long time to train the pilots, and it takes a large support force of training aircraft to produce the pilots who will fly the missions the next year. Our force is inaccurate. The CEP of weapons delivered in North Vietnam can be embarassingly well determined from pictures of the distribution of craters around bridges. In one case, it turns out to be something more than 700 to 900 feet.

But there are some glimmers of hope. Walleye is one of them, Condor another, and the Air Force Pave Way bomb, one of my favorites. I expected to have to explain Walleye and Pave Way but I think I don't have to at the moment. Now, what do we need? It seems to me we need a more rapid delivery of ordnance in response to a request. We have a one to three day response cycle except in the case of close air support. That's too much for many targets. We need better accuracy with nuclear weapons and with conventional weapons. Why should we accept 700 feet CEP when we could get something better, 100 feet, 20 feet, or zero? We need to reduce the vulnerability of our bases, of our men, and of our delivery vehicles, We need a lower investment cost, it seems to me, even at the expense of higher expendable cost when war comes. In that way we could have a greater capability, and we could move to the traditional high production posture which has characterized the US during war time. And we need less degradation of capability against heavy defenses. In Vietnam, when the air defense system took a jump in capability, we were thrown into disarray—in some cases transferred our attention from important targets to less important targets because we could not tolerate the losses in flying against the ones we really wanted to hit.

Now, in achieving these goals we can look at the changing technology of which you've just had a view. We can look, for example, at a modern force—not one which has grown incrementally and traditionally as has that of the US, but one that was built up essentially from nothing after the war; that's the USSR's, and it is quite different from ours. They have, as you've heard, no verified nuclear capable tube artillery; they have emphasized long range and short range missiles for the delivery of conventional warheads, nuclear warheads, and chemical warheads. They have no aircraft carriers. Recently they've been building helicopter carriers. They have placed a great deal of emphasis on flexible cruise missile systems, and I'm going to talk a lot more about that later. And finally, in addition to technology and the Russian force, we can look at the experience in Vietnam where we spent a great deal of money against a not very promising target array—not knowing that all we needed to do was to kill certain particular targets.

It's traditional in improving our force structure to identify a single weak point and work on it. It seems to me that we're at the end of that road; it takes just too long, and after we eliminate a weak point, another weak point shows up. One example is the problem of truck interdiction in Laos. This was characterized three years ago as an inability to find the target. We knew there were North Vietnamese trucks operating in Laos. We had critical agreement whereby we could attack them from the air but we just couldn't find the trucks. Well, that problem was solved by the use of night vision devices and by air-emplaced sensors; but this only revealed an equally severe deficiency, namely, we couldn't hit the targets after we had found them; we couldn't hit even a few of them. That problem, in turn, was solved qualitatively over a period of a year or two in various ways: by the AC130 gunship, a very effective truck killer; by the M36 incendiary cluster bomblet delivered by A1 or B57 aircraft; by the Pave Way laser guided bomb delivered from two F4's; or by one C130 forward air controller aircraft with the Pave Way laser guided bomb delivered by another against the truck illuminated by the FAC. But the problem still wasn't solved quantitatively. We had insufficient effective aircraft. We had one AC130 gunship; now I think there are six. We had Pave Way bombs produced at 200 a month, most of them destined for North Vietnam and not for defense suppression or for truck killing in Laos. We had M36 incendiary bombs the procurement of which was terminated, so there has been a whole year's gap in that capability. So even though we knew how to kill trucks, somehow we could not make the administrative and operational decisions to do this job.

The lesson I want to draw here is that attacking the weak points allows one to move only sequentially toward a better capability, with each step taking several years. With a development cycle ranging anywhere from 8 to 18 years in our normal peacetime procedure, it's important that we build new systems only when they are major improvements. But it's also important to fix up the old ones quickly, when we can make a major functional improvement without changing the entire system. One example is adding the demonstrated capability of LORAN line bombing to the F4 fleet. Experience in Vietnam and Laos has shown that, by LORAN line bombing, one can deliver weapons from level flight at 10,000 feet with an accuracy of 50 meters CEP in all weather. That's a lot better than visual bombing with an F4, and about a factor 3 better than the MSQ77 or 95 radar controlled bombing.

Now I'm going to talk about a system which seems to me to solve a great many of the current problems all at once. The system has had extensive discussion and review, and its technical feasibility is not questioned. There's considerable dispute over costs, but this, to my mind, does not change the desirability of the system. The key to this approach is to provide certain services over an entire war theater so that the individual vehicles using these services in flight can be made as inexpensively as possible. There's a lot of precedence for this, for instance in civil aviation. There's the VOR or the Decca navigation aids for aircraft, which represent a substantial ground investment but allow the aircraft to operate with very little in the way of on-board equipment.

I want to discuss how to fulfill one of the major purposes of military forces, which is to fight, to destroy, and to kill targets—that is, to deliver weapons. Now to deliver weapons on targets takes more than accurate delivery; it takes intelligence, so that one knows the relative importance of targets, reconnaissance, and surveillance. I'm not going to emphasize here how this can and should be done; it is a very difficult problem. In the Walleye/Condor presentation you heard that one can sometimes do reconnaissance during the strike. In fact, that seems to be a very good way, and the system I propose has some of those same characteristics.

But here I want to stress the advantages to be obtained from using theater services as a basis for weapon delivery systems and not just as a convenience. My observation is that almost all of the strikes are upon targets determined by prior reconnaissance. When the target itself is not determined by reconnaissance, the point of attack is determined by reconnaissance. That is, one knows that there will be a train at a certain point, perhaps approximately at a certain time, and one can arrange to attack that point—if not precisely at a certain time, then with a mine which can be actuated by the train when it comes along.

So here I will emphasize prebriefed attacks on fixed targets. Figure 1 illustrates an elevated relay, an elevated line of sight which aroused the communications center over on the left, which I've mounted for mobility in a van to communicate with all kinds of vehicles in the field. These are over on the right: supersonic aircraft, bombs falling from aircraft toward a target, drones of various kinds. In general what I want to do here is have a wide band theater communication capability, which allows not only higher authority but real-time command instructions from the center on the left to the vehicles on the right. So the elements of this system are (a) the delivery vehicles (as inexpensive as possible); (b) the relay; and (c) the control and direction center which, after the planning of a mission, operates in large part automatically. I'll discuss later the possibilities for the relay to extend the line of sight (see Figure 2). We have a time-shared directional communication and control system. It turns out that one doesn't need to send commands at every instant to every vehicle; as you can see, something like a 10 second command period is adequate for midcourse and perhaps a 10 per second command rate for final attack. After the planning target identification, proposed time on target, choice of weapon and so on, the proposed flight plans would be stored in a computer and made good automatically by the controls which are sent to the vehicles.

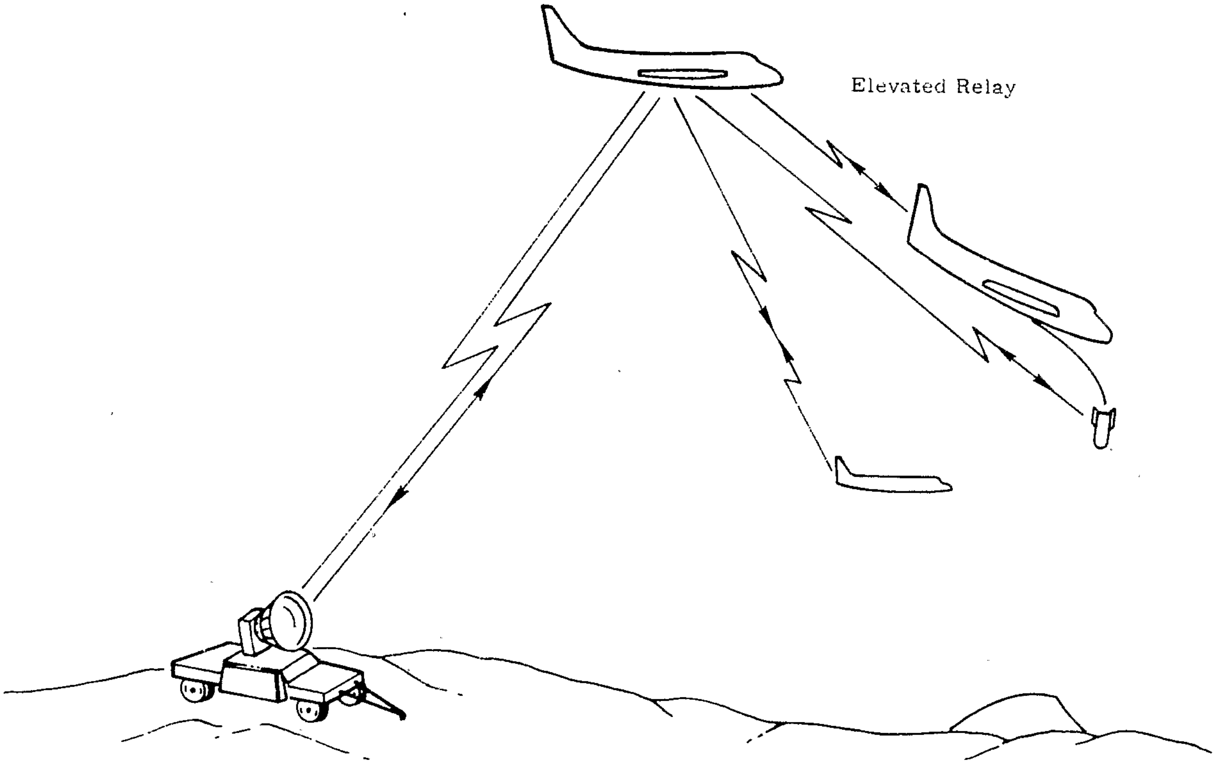


Figure 1. Elevated Relay Operation

THE SYSTEM

Elevated relay to extend line of sight.

Time-shared directional command and control.

Accurate, multiple-user, low-cost theater navigation and location (20 feet)

Remote-guided weapons:

- bombs
- artillery
- ground-launched cruise missiles.

Advanced mines and target-actuated munitions.

Figure 2

The elevated relay is much used now in Vietnam and Laos in the Igloo White system in which one has orbiting aircraft, either manned or droned, which communicate via VHF with the UHF command link and an S band composite link to the direction center. The communication system in Igloo White is time-shared, but it is not directional. It could be made directional by the use of a phased array antenna on the aircraft, and in case of enemy jamming presumably it would be.

The accurate multiple-user low-cost theater navigation and location system with 20 foot accuracy doesn't quite exist either. We are just about to try in the Fourth Corps of Vietnam such a system with about 100 foot accuracy, namely, a LORAN retransmission system in which the 100 kilocycle LORAN signals are remodulated onto a UHF radio and fed into a standard LORAN computer back at a direction center. However, that's the kind of system I'm talking about—one in which the onboard or, in this case, patrol-borne equipment costs may be a few hundred dollars and which gives location accuracy equal to that obtainable from a $20,000 to $100,000 system.

In the remote-guided weapons-in bomb category, we have Bullpup and Walleye, and we have Condor coming up. We have no remote-guided artillery shells to my knowledge, but there's absolutely no reason why a 16 inch shell, or for that matter an 8 inch shell, cannot be fitted with the same homing or guidance device that one puts on a bomb, thereby providing a very rapid response, high fire power capability to deliver support over a limited area. And finally we don't have any ground launched cruise missiles; we have Mace, but that is not remote-guided. The Russians have ground launched, air launched, and submarine launched cruise missiles with which they communicate in flight, and these pose a very severe threat to the US. Advanced mines and target actuated munitions are to fill a deficiency in the proposed system as well as in our present system, namely, to make a rendezvous with an uncooperative target which isn't there when you get to the proper point. The best thing in such cases, I think, is to deposit a munition which waits until the target comes along. With inaccurate delivery that has a further advantage that the ratio of the kill radius to the CEP enters only as the first power instead of the second power as it does with a bomb which explodes on contact.

Figure 3 explains position fixing by microwave ranging. The LORAN system uses three fixed transmitters in the 100 kHz band and, with a signal-to-noise ratio typically less than 1, determines location to very good accuracy.

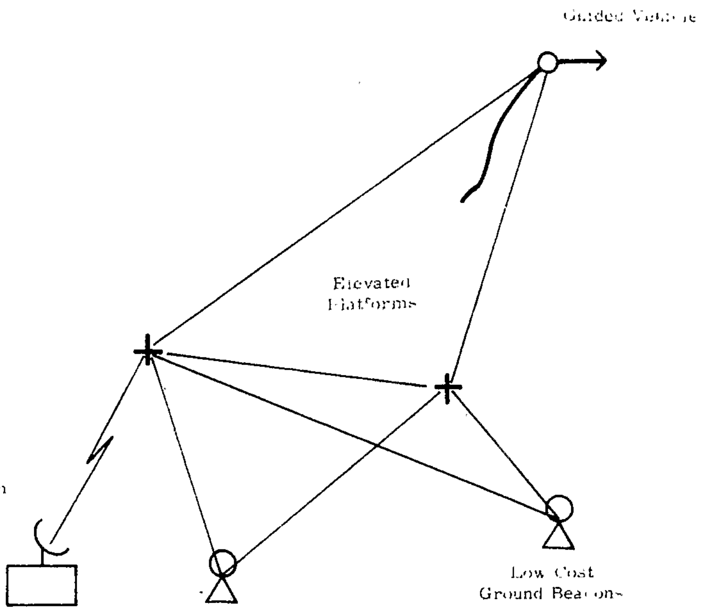


Figure 3

The prompt system allows less expensive onboard equipment for filtering over a long period. The direction center communicates with a couple of aircraft or elevated platforms—they could be balloons, satellites, whatever you like. Down on the ground are two low-cost beacons; they weigh a few tens of pounds and cost a few thousand dollars; there's another one of those in the vehicle that is being guided on a peculiar trajectory. Every once in a while one of these aircraft or the direction center sends a pulse which then runs around the whole system. Its time over each leg is individually measured, and the time to the vehicle and back is measured. That allows one, for instance with this time, to determine that the aircraft is on a sphere of a certain radius from beacon A and on a sphere of a known radius from beacon B; the intersection of these two spheres is a circle. If one knows also the aircraft altitude—which for these long range cases is all that's necessary—then one has aircraft 1 fixed in space in plan to an accuracy of a few feet, relative accuracy, anyhow; and the same for aircraft 2. The baseline up in the air is used to determine the position of one vehicle or hundreds of vehicles. The QRC334 system under development and test does this; so far as I know, it has not been tried with ground beacons.

Now the elevated relay, if it's not to be a satellite, has a horizon limitation probably of the order of 200 miles from 40,000 feet altitude. One isn't limited to 40,000 feet; one could have aircraft at 80,000 feet or balloons at 100,000 feet. The relay cost is amortized over a very large number of vehicles and over a very large expenditure of vehicles in this proposed system. One doesn't need very much transmitter power because the relay communicates wide band over a very directional antenna to the direction center at short range, whereas it communicates at long range only a few commands in appropriate time slots to the vehicles.

Now antijam capability is needed eventually. A system like this, in my opinion, can grow so that one fields it initially without much capability against jamming, and then as the need arises fits the expendable vehicles with antijam features. The duty cycle is very low, as I said; hundreds of vehicles in flight need to have command updates only every 10 seconds and one needs only a single elevated platform for the relay (but two or more for time of arrival position fixing). In addition, of course, one might want to have several more elevated platforms and switch the control from one to another in order to reduce the susceptibility to attack by homing missiles on the other side. So at the bottom of all this is a computer (see Figure 5). The computer can be way back, it can be 200 miles behind, or 400 or 1000 miles from the elevated relay. It can be in the most secure location in the theater; if we can't find a single secure location in the theater, then, gentlemen, we have a very difficult problem. But there's no reason for the computer to be up there in the van.

CHARACTERISTICS OF ELEVATED RELAY

Line of sight from 40,000 feet: 200 miles.

Communicates to and from hundreds of vehicles.

Little transmitter power needed.

Low duty cycle on most links.

Single platform for relay, two for time-of-arrival position fixing.

Figure 4

The computer manages the communications, it knows when each vehicle requires to be commanded, it knows when each vehicle is receiving the distance measuring pulse, and it listens to that vehicle with appropriate directivity at that time. It can also implement a schedule of frequency-hopping or other kind of encoding in order to reduce the susceptibility to jamming. The computer updates the position information for each of the vehicles; it knows where the vehicle was, it can extrapolate where it is, and it need make only very small corrections to this extrapolated position so that the program is quite a simple one. The computer manages the flight for the missiles, bombs, and artillery shells; in principle, it can pick them up at any point. There is no reason for a missile to be launched from the computer location. It can be launched from a field, supply depot, or merchant ship, anywhere in the area. It's best for communication to be established with it before it's launched, but not absolutely necessary. Finally, with midcourse navigation being taken care of by the computer, if the vehicles, particularly the cruise missiles, have some kind of drag modulation (which might be easier than thrust modulation) one can implement very accurately the precise time on target and get the missile there within a second or so of the desired time, and within midcourse navigation accuracy at least for target acquisition. That means that the manager of the system, the person who happens to be flying the missile at the target end, need only seek the target within a region of 200 to 500 foot diameter. He doesn't have to look all over a several mile acquisition window for the target, and so he has an easy job. We can use the US commercial standards, degraded as they will inevitably be in combat; 200 line TV is good enough for this particular job. Well, to reiterate, what I would hope to achieve is a midcourse navigation accuracy of the order of 200 feet, and that's compatible with a 10 second command and position interval with onboard auto-pilots, with angular errors of the order of 1 degree and accelerometer errors of the order of 0.01 g (see Figure 6).

COMPUTER ROLE

Computer-managed communications.

Computer-derived position data.

Computer-managed flight for missiles, bombs, and artillery shells.

Computer-managed target acquisition.

Figure 5

For unmanned vehicles the computer ordinarily would not bother with the air traffic control problem; if there were two drones lying in the same neighborhood it would just regard the probability of their collision as low and fly them anyhow. After all this is a war and the other guy is going to be shooting at them; if occasionally we lose two by midair collision that's just too bad.

In the terminal phase, with these same onboard instruments of 0.01 g and 1 degree accuracy and a 10 foot command interval, one can realize in principle about a 2 foot error. This is not important. I only asked for a 20 foot error here because there are systematic errors in the system. There is the variation of relative humidity of the air, there is the variation of temperature and barometric pressure and, unless one has some kind of calibration near the target area, such a microwave ranging system is unlikely to be more accurate than about 10 feet. And 20 feet is not necessarily a conservative estimate for the absolute error in flying an artillery shell or a missile into a target. One has various options. If the target altitude is not known very accurately, one might want to fly the missile over and then vertically downward as is the case with Nike Hercules, for instance. But the chief importance, to my mind, of midcourse navigation accuracy of this magnitude is to allow one to do target acquisition with very moderate use of the necessarily rather wide band TV link, so that a single elevated platform could devote its fairly scarce direction band width product to listening to or looking at one missile for a period of the order of 5 seconds. At that time the operator could designate the target in the field of view from a predistorted reconnaissance photograph which he has next to him. And at that time either the computer could take over Walleye type tracking and fly the missile into the target or, in case one has to worry about screening of the line of sight by ground obstacles, an onboard tracker could be implemented, as has been done so successfully in Walleye and Condor.

SOME SYSTEM PARAMETERS

Midcourse navigation accuracy 200 feet.
  On-board instruments 0.01 g, 1^{0} error.
  10 second position and command interval.

Terminal phase — 20 foot error.
  0.1 second position and command period.

Target acquisition by 5 seconds of TV.

Single time-of-arrival navigation system
  100 drones in midcourse
  10 vehicles in terminal phase.

Pulse-jet, 500 mile cruise missile
  1000 pound payload. Perhaps $25K at
  3000 per month.

Figure 6

Early looks at the time-of-arrival navigation systems—from the standpoint of which could be implemented more expensively with LORAN retransmission and which less expensively with pulse microwave distance measuring—indicate that a moderate size computer could handle 100 vehicles in midcourse at the 10 second period and at the same time some 10 vehicles in the terminal phase. The missile I would like to use with this system is just as inexpensive as possible. Now you all remember the

V1, which was a pulse jet missile of 150 miles range and low subsonic speed. There has been some work recently on French pulse jets with a specific fuel consumption of about 2 pounds of fuel per hour per pound of thrust. It turns out one can sketch a reasonable missile weighing about 3000 pounds and having a 1000 pound payload, 1000 pounds of structure and avionics, and 1000 pounds of fuel, which would travel 500 miles at Mach .7 or .8. Then the real question in all this is, suppose that you really relied on such a missile, how little could you buy it for? Remember that it doesn't have to be compatible with aircraft; it doesn't necessarily have to be safe for aircraft carriers; it's going to be shot at anyhow, so the reliability of 70 or 80% is probably adequate; if it doesn't work, you just push it overboard from the launching site if you happen to be a merchant ship, or you fire it away in a field someplace; you don't repair it. From the fundamental as opposed to the technical point of view, as you say in the stock market, it seems that one could make such a thing for $25,000. Comparing Walleye at $15,000, the tactical telemetry for Walleye at something between $1000 and $3000, rocket assisted takeoff for ground launch, which is about $400, it just seems that $25,000 would be a reasonable amount. If one goes at it from the other end and asks how much it costs to modify a Ryan Fire Bee (of which the airframe plus engine costs, I think, about $45,000), it looks as if one could buy such a system for $65,000 without the remote TV, and about $80,000 with the remote TV. One could also approach it from the point of view of Condor, except that many of the expensive parts of Condor are already built in and it's going to be hard to engineer them out. So this is a super V1 which flies in very high class theater services. With such remote guided weapons I would hope to get 25 foot CEP by navigation alone (see Figure 7).

REMOTE-GUIDED WEAPONS

25 foot CEP by navigation alone.

200 foot midcourse guidance:
    for penetration and terrain avoidance, eases target acquisition and TV needs.

For attack on moving targets designated by remote sensors or designators.

For accurate delivery of mines.

For high assurance of timely strike.

For greater capability against heavy defenses.

Figure 7

These are conventional weapons for the most part. When one flies one of them into an area, one has done a calibration of the area and so the day's work might begin with flying a TV-equipped remote-guided weapon into a target area, calibrating several square miles—in that way introducing into the computer a bias which then takes out propagation anomalies—and for the rest of the day flying less expensive missiles without TV. The 200 foot midcourse guidance can be used to implement terrain avoidance without any onboard radars. You know that the F111 has two onboard terrain avoidance radars; these present the pilot with continually confusing pictures, but the system is automatic so he doesn't have to look at them. The F111 terrain avoidance system works extremely well, but it is expensive, it adds weight, and it is also a means by which the F111 can be detected.

Now there's a different way to do terrain avoidance. We know very well what the elevation of the ground is at many points over the world, including many in the Soviet Union, certainly all over North Vietnam. And so if we know where the vehicle is, we know at what altitude it ought to fly to be 200 feet, 500 feet, or 1000 feet above the ground. And by the combination of a barometric altimeter and an accurate navigation system one can do very good terrain avoidance. One would like to be able to reset the barometric altimeter every once in a while, and that can be done by introducing a downward looking radar altimeter which is used to update the barometric altimeter while over terrain known to be flat and not confusing. If one has moving targets (for example, trucks in Laos), close support targets where there's somebody in the neighborhood of the target to do a better job than one can do by navigation, one can have there a pulsed laser, say the one which is used with the Pave Way bomb, a 10 per second 1.06 micron laser, which designates the target to be picked up by a laser guidance unit instead of a remote-viewed TV. In this way one can have the vehicle, the artillery shell, the bomb, or the cruise missile actually strike the target.

I have already pointed out that in some cases one wants to deliver mines onto a road to impede travel or to destroy vehicles. There is a concept known as strike mining: You know that a train is coming along, you can see it in the distance, and so one or two minutes ahead of the train you put mines on the track or in the track, if that's more convenient to you than striking the train itself. There was a train which used to go nightly between Hanoi and the Chinese border, round trip. It used to be in China at the beginning of dark, it was back in China at the end of dark and, for the most part, there wasn't a thing we could do to interdict that railroad track. There were occasional periods when the track was severely broken for a few days. But we never had the capability, when bombing North Vietnam, of striking the track with assurance ahead of the train and behind the train, so that the train would be there during the daylight hours. Now we could do that with a system like this.

Finally, as the intensity of defense increases it gets vastly more expensive to conduct manned bombing operations through these heavy defenses. With a $3 million airplane, if one takes four Walleyes and adds $40,000 cost per sortie aside from the munitions, that's about $100,000 to deliver four weapons on the target. We know they only strike the target with 80% or 70% accuracy, but I hope you'll be as generous to my cruise missiles. And that turns out to be about $25,000 expended plus some imponderables per target struck with Walleye. Going into the target, lining up maybe on two, three, or four different targets and coming out, the attrition on the support aircraft can be estimated as of the order of 2% on a $3 million aircraft, and that adds about $60,000 more to the cost of the sortie; the cost per target then rises to something like $40,000. Actually it's worse because one hesitates to send aircraft into regions where the attrition is of the order of 1%. If the attrition is 5%, as was the case in some parts of North Vietnam at some times, the attrition of the aircraft may contribute from $150,000 to $200,000; actually even more, because one puts a lot of ECM equipment on the aircraft and one has a lot more support equipment. And so somewhere between zero percent attrition at $25,000 per cruise missile and 5% attrition at $80,000 per cruise missile it becomes cheaper and, I think, more effective to use cruise missiles rather than aircraft. Of course, nothing forces you to ground launch these cruise missiles. They could be launched from airplanes too, but it seems to me that's the way to assure their being very expensive. I think you'd probably get cheaper missiles by making them ground launched and adapting them later to aircraft.

Just to summarize how far we are from these remote-guided weapons, you heard all about Walleye and the Walleye with the data link, and the Pave Way bomb with an adaption kit on its nose and some fixed wings added to its tail (see Figure 8). The 750 pound and the 2000 pound bomb have been extensively used in Vietnam. The price of the current Pave Way kit is about $5000 in any quantity; at the rate of 1000 or 600 per month they will be $3500 each. It turns out to be very desirable to use 500 pound bombs because then a single aircraft—even a light aircraft like the A37 or the A1—can carry a goodly number of them and the per sortie cost for delivering Pave Way bombs onto targets goes down. I don't share the enthusiasm of General Glasser for the electro-optical or the IR guided Pave Way. I think one ought to concentrate on the laser guided bomb.

SOME PRESENT HOMING OR GUIDED WEAPONS

WALLEYE -- 1000 pound electro-optical tracking glide bomb. ≈ $15K.

PAVE WAY -- 750-pound and 2000-pound (500 pound)
laser-guided bomb. ≈ 5K.

ARM: SHRIKE, Standard ARM, etc.

Soviet Cruise Missiles:

STYX

SS-N-3, etc.

Figure 8

We have so-called antiradiation missiles whose purpose is to go against radars. These are the Shrike, and now the Standard ARM, which is much fancier, and can be launched in other directions than straight at the radar and has a broader spectrum against a threat as well as a bigger warhead. The only trouble with these is that the radars typically see them coming and they shut down so that the antiradiation missile doesn't have anything to home on. In my opinion it's much better to locate the radars accurately, to within 50 feet or 100 feet, and then send one of the standard weapons that we have been talking about after it. Radars being typically fairly soft, they can be killed by a Walleye with 1000 pounds of explosive at some tens of feet. The same time-of-arrival distance measuring system which I propose to use for flying these missiles, bombs, and artillery shells can be used; in fact its original purpose was to locate radars very accurately.

Now, of course, the Soviets are away ahead of us on these things. They've sunk the destroyer Elath with the STYX missile, actually fired by the Egyptians, I think. They have longer range cruise missiles, the SSM3, for instance, and they believe that cruise missiles are a very good way to do business. They have not a single aircraft carrier. Not only are the cruise missiles in competition with aircraft for attacking land targets, they're also very useful for attacking seaborne targets like aircraft carriers. They're a threat that worries the Navy and me very much, these days.

I propose to concentrate on a very few weapons. The Pave Way bomb, for instance, can use the same kind of servo that it has now, and have the laser guidance taken off and replaced by a time-of-arrival beacon so that the time-of-arrival navigation system can determine where the Pave Way bomb is at every time and can guide it all the way down to the target. This means that the most accurate delivery could be obtained by flying an attack aircraft F4 (or whatever) at 25,000 feet, delivering the Pave Way bomb into a basket of several miles in diameter and then guiding it to the predetermined target location by navigation and command.

Rocket assisted artillery shells, and even wings, are sometimes talked about. The only trouble is that the accuracy of the artillery is typically degraded, not only by the longer range but by the uncertainty in the lift or rocket propulsion. One can guide the shell too to an accuracy of the order of 20 feet, especially if there's some kind of observed fire so that one can correct for later rounds. And for the cruise missile, if one can build the pulsed jets for a few hundred dollars instead of the turbojets or turbofans for $10,000, we already know how to do the remote terminal television which has been demonstrated on the Walleye with data link. We know how to do remote command of midcourse which has been demonstrated on the Condor. The navigation and terrain avoidance, I think, one can work out for oneself. So, in my opinion, there are three very useful weapons which could be used with such a system.

And then finally one gets down to the difficult questions, since there's more than one kind of relay platform to use (see Figure 10). How do you choose? In Vietnam we've used slow manned aircraft EC121's. We have a slow drone aircraft, a Beech Debonair, which does somewhat better than the EC121. These have endurance of the order of 10 to 15 hours or so but are limited in altitude to 20,000 or 25,000 feet. One could imagine doing development on high altitude helicopters to ease the problem of having directional antennas, which could then be hung from the helicopter. But since the directional antenna has to be a phased array in any case to switch from one vehicle to another, the helicopter doesn't really help. When I try to sell people tethered balloons at high altitude, all the pilots explain what a hazard it is, and I think that's probably true—although in the siege of Britain they provided tether warnings by running current up the cable to tell the pilots where the tethers were. From a more fundamental point of view, it turns out that if you have to design against a wind of about 100 knots in order to keep position either with a tether or a powered balloon, you're better off to obtain the lift from wings. And so probably a slow drone aircraft will win out.

PROPOSED WEAPONS

Pave Way: time-of-arrival-commanded navigation.

Artillery: time-of-arrival commanded navigation plus rocket assist, plus laser seeker.

Cruise missile: pulse jet, plus remote terminal TV, plus remote-commanded midcourse navigation and terrain avoidance.

Figure 9

CHOICE OF RELAY

Balloons, tethered or powered.

Slow manned aircraft.

Slow drone aircraft.

High-altitude helicopter.

Satellite.

Figure 10

RESULT

Reduced basing vulnerability--little value exposed.
Small investment/high production system.
Cost rises slowly with intensity of defense.
Provides improved close support.
Can reduce peripheral damage.
Radar location with strike by normal weapons.

Figure 11

After you do all this what do you have? (See Figure 11.) Well, it seems to me that you've reduced the basing vulnerability to the extent that you rely on such a system for attack of fixed targets and not on aircraft. You've reduced the basing vulnerability; you no longer have in this combat area large aircraft carriers with a billion dollars or more of embarked worth and surrounded by another billion dollars of task force; you don't have long runways to be cratered. You have several redundant elevated platforms and—someplace back where it's safe—a computer. You have vehicles which cost from a few thousand dollars for the bombs and artillery shells to $20,000 to $100,000 for the drones. A very interesting thing happens if you can get the strike vehicle cost down to $20,000 or $50,000 because that's the range of cost for the guideline missile which the Soviets use with their SA2 radar system; and once it cost them as much to fire a missile at one of your drones as it does for you to send the drone over. Then you can send drones freely, and every missile they shoot is part of a production race with the US, which we can run very well. In fact, if they start shooting these things down, one can send cheaper drones whose only purpose is to attract SA2 missiles. Only a small investment would be required—that for developing the elevated platform if it is needed for proving out the high accuracy navigation system for continued work on antijam techniques.

Satellites, especially synchronous satellites, are very good for communication, but they're not really ideal for control in this case because the round trip time from the vehicle through the satellite, back to the ground, to the direction center, back to the satellite, and to the vehicle again, is about a half second. For some purposes that's all right. Clearly it's all right for midcourse command. It's also all right for designating in a picture the portion which the onboard tracker is supposed to home on, but it's probably not good enough (although that remains to be seen) for manual flying of the missile.

The cost of the system that I propose rises only slowly with the intensity of defense. If, instead of 1% attrition on the missiles, the attrition rises to 30%, well, that's just too bad. The cost of the system per target destroyed rises by a factor of 1.4. If it was $30,000, it's now $42,000. But when you have a defensive system with 30% attrition on manned aircraft, you just stop attacking those targets, at least with conventional weapons. One can provide improved close support in this way by giving a greater range and a greater accuracy to corps artillery, or to Naval gunfire, for that matter. And as the previous speaker noted, one can reduce peripheral damage, because at least in the case in which one sees the target through the remote TV, or in the case when one has accurate navigation, one can dud or blow up the warhead in flight. And finally the system provides a means for striking radars without having expensive and special purpose antiradiation missiles.

Question and Answer Period

McDONALD (LRL): There's a study that the Army made fairly recently (I believe the Navy has a similar one, as does the Air Force), in which they wanted to have the onboard seekers essentially a TV system on a missile which would fly over the target area. The operator back at his base, looking at the output of this system, would cause the missile to fly into the target. As I remember this study, the operators, even after a great deal of training, had great difficulty in recognizing the part of the target they wanted to home in on, unless the missiles were at high altitude and the targets could be watched for a long time. It seems to me that an important part of your plan here is to be able to identify the target in some reasonably brief period of time, particularly if you're time-sharing. What do you comment on this?

GARWIN: I think such proposals have always been evaluated without a very accurate midcourse navigation system, and the key here is that the field of view when the TV goes on will be from a known direction and will have a 200 to 500 foot diameter. I think probably we're in shape now with the Condor to put such a concept to the test, because the pilot of the Condor-bearing aircraft can line it up roughly and then somebody on the ground can see whether he can designate a 1 foot area or a 2 foot area within the 200 to 500 foot field of view. It also has something to do with the design of the cruise missile because in any kind of wind the missile crabs, and you would like to have a system in which the TV can be bore-sighted and not gimballed; so you would like a cruise missile with direct lift control and not airplane type elevator control.

McDONALD: My memory of the main problem they were having with these had to do with optical contrast. They made very large differences according to whether or not the target actually was standing out in the background.

GARWIN: Usually people talk about flying and observing essentially without accurate navigation. Here if the TV goes on 5 seconds before impact, and one has a missile of the order of 700 foot per second speed, the range is only about 3000 feet; with normal visibility, even at night, there's a possibility of illuminating a 200 to 500 foot diameter region with an onboard light or with an ahead fired flare. I haven't seen the particular studies you refer to; I've seen others, and they lack the accurate navigation which allows one to reduce the field of view.

(Speaker Unidentified): Two things concern me in regard to putting the control devices on artillery. First, I think we're buying ourselves some trouble here at an increased cost. I think the beauty of artillery is the fact that it can be fired in an environment where communications are bad. Second, I'm concerned about the effect of the degradation of communications on the nuclear battlefield on all these control devices.

GARWIN: These would be line-of-sight communications to the vehicles, probably UHF or L-band, and there wouldn't be degradation unless one had a fireball in the line of sight. If you've ever tried to kill an enemy gun with artillery, you know you have to shoot an awful lot, and you don't know whether or not you've got him. They're very hard targets for artillery—on which an improvement in accuracy from the 30 meters or so which one gets at maximum range to just a few meters would be well worthwhile. We don't have to change all of the artillery shells.

(Speaker Unidentified): My second question was prompted by the study that was presented on tactical nuclear warfare, '72 to '78. They had a section in there on the effect of high altitude bursts on communications and on electronic systems; it just strikes me that this would defeat a lot of the utility of nuclear artillery.

GARWIN: One has to look at these things in great detail. The effect on electronic systems is large when you have cables, etc., and small when you have essentially shielded microwave communication systems. Now there are effects on the ionosphere varying the path length, which would somewhat change the biases in a microwave location system.

WHEELON (Hughes Aircraft Co.): I think that Dr. Garwin has helped us to understand, at least in part, why the Soviets favor and have bothered to inventory over these years a system that looks surprisingly like the one described. However, I'd like to comment that, by throwing the burden away from carriers and runways and expensive manned aircraft, it seems to me you've put the burden back on several of the elevated relays. Why aren't those good targets to knock out the whole bombing capability?

GARWIN: They are good targets; but they are also very low cost targets. They are relays, they are unmanned, and the Beech Debonair costs about $300,000, fully equipped. If one has a number of them (and of course they can be protected), they're way up there, they can be seen by the enemy for a long distance; but from a ground station you can also see threats approaching from a long distance; you can turn them off and still maintain the capability by having a round robin among emplaced or embarked, elevated relays.

WHEELON: I would have thought that if they are, in fact, servicing a fleet of 100 of these vehicles or shells, and they're pretty busy electromagnetically and it would be hard to turn them off for very long, and why doesn't an ARM working against these constantly radiating sources work pretty well?

GARWIN: If I need two operating in order to obtain not only relay but navigation capability, then I'll have three or four up at any time. When I actually see a threat, a missile approaching one of them, I will turn it off, because I have a computer on the ground, and I know the location of the other aircraft—or I will have that location within a tenth of a second—and I can transfer the system entirely to different elevated relays. Of course you can say, "Suppose they use semiactive radar homing or something instead of just home-on-jam or home-on-electronic emission?" Well, I'll have a lot of these and maybe I'll have to stand down once in a while, but that's not going to be a cheap missile, either. Now if I have to use high performance U2's or something like that, then they become much more desirable targets than if I can work with cheaper aircraft. And I think probably one of the objects of such a system in growth would be to have lower cost, very high altitude relay platforms.

(Speaker Unidentified): I believe we've stepped forward in a couple of things here, but the accurate navigation of destructive agents into most of the land warfare targets isn't really the problem. I wonder if this system couldn't be "bent" to solve the precision target location problem, which at the current time runs greater than 300 meters. A 20 foot miss distance against a target of some uncertainty of the order of 1500 feet surely is not what is being sought.

GARWIN: In answer to that question, I guess I ought to say something about intelligence, reconnaissance, and surveillance. It would be very nice to be able to deliver in this case not a destructive agent but a parachute-borne TV whose position and orientation are accurately known. To illustrate: Around Khe Sanh we really had no good idea of the location and pattern of the trenches. We had no way to tell what was happening there for some days; it was too dangerous to fly in the neighborhood, and we didn't have any photo coverage available to the Commander. If one were satisfied with fairly low resolution television or with a scanning device of some kind (not a real-time frame TV), one could get very nice pictures at the cost of some tens of thousands of dollars per picture. Now that sounds like a lot, but you waste a lot more than that if you don't have the picture when firing artillery all over the area. You don't need this system to obtain parachute-borne, balloon-borne, or missile-borne TV, but it's a lot easier to do it in the context of such a system.

PAYNE (Martin Marietta): If we implement your proposal, what do you do with all the tactical aviators?

GARWIN: I expect some of them will be worn out in a battle I'll have after this meeting. The ones that are left we'll have to put to work somehow.

GIRARD (RAC): I'd like to comment with regard to history. The Soviets came out of World War II with at least as much tube artillery as we did, and then they saw fit to completely re-equip to an extent that perhaps we have not. There are many anomalies in Soviet force structure—their fixation on assault guns, for example, when right after the war we said there's just no future for this kind of thing. I think that some of the asymmetries in force structure that tend to be pointed at with alarm are a function of strategic and mission asymmetry and not dull-wittedness on the part of one side or the other. Now another point; it also seems to me that in 1944 the British put together an extremely effective defense against the last cruise missile that was operationally employed, the V1. Perhaps you'd comment on that. My other comment is, maybe I misunderstood something, but I heard a lot about navigation and I didn't hear much about what I would call tactical communications. Maybe there's a definition here that would help me out, because particularly in supporting troops, the communications and coordination issues are very large, and it really isn't completely dominated by navigation.

GARWIN: I can only agree with your first and third points. I didn't really discuss all the tactical communications; I don't know very much about it. I'm sure it ought to be done better with digital communication and automatic receipt. The British defense against the V1 was very effective and I saw the figures recently—something like 40% of the V1's never got anywhere near their target because they aborted or they were pointed wrong or they failed in flight. Only a few percent of the last V1's fired actually struck in the intended area, but that's because those aircraft flew slow and straight and level. When I say the computer provides mid-course guidance, I should add that it doesn't fly straight, it does terrain avoidance when desirable; otherwise it's flying 1-1/2 g turns at reasonable altitude and that just plays hob with the effectiveness of artillery.

CRAWFORD (NWC, China Lake): I know this 5 second interval has been subject to question several times, and it occurs to me that North American and Martin and several others have excellent terrain models on which this could be simulated so that we could get a positive answer to that part of the question. Second, I hesitate to needle on this subject because I happen to think that the long range missile's a pretty good idea, but on its use for things like trucks you have to launch the missile an hour before the truck gets to where the observer is, and that concerns me a little.

GARWIN: That's right, and in that case one would have two choices. You would have a supply of missiles loitering, and why not have an aircraft loitering with a guided bomb—that's even better when the air defenses will allow it. That's a case when aircraft are, in fact, better than missiles. You could have missiles loitering which would be diverted to secondary targets just as we do aircraft when they don't have targets of opportunity. But even better, you could use the missiles to deliver mines very accurately. It sounds like a waste to spend $25,000 or more to implant a mine in a road, but one doesn't have to be content with a single mine; the missile can run down the road for a piece and drop a VLM antivehicular land mine (or whatever is the current rage at the time) and potentially kill a number of vehicles. Another use for such a thing would be to suppress triple A and to allow aircraft in the normal way to deliver munitions, preferably guided, not free fall, which are then very cost effective against trucks. But you're right, moving targets are very hard to get with aircraft, or missiles, for that matter.

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Major James B. Murtland III
USMC

US MARINE CORPS TACTICAL NUCLEAR WEAPONS REQUIREMENTS

The Marine Corps is not unilaterally developing any nuclear weapons or delivery systems; in this respect, it is similar to the CINC's. We state our requirements and attempt to influence the development programs of the other services to accommodate our requirements. We look to the Army for our ground systems and to the Navy for the air delivered systems.

USMC Philosophy

The Marine Corps is a general purpose force organized and trained to conduct amphibious operations in any environment to include active nuclear warfare. Our primary interest is in tactical nuclear weapons, although we have had limited involvement in the SIOP. In the past we have relied on dual-capable delivery systems and are not aware of any developments which would cause us to change this policy in the future.

There are differences between the Marine Corps' operational environment and that of the Army. The first is in the area of command and control. We do not envision Marine forces being deployed in cold war barrier operations such as the Army encounters in Europe and Korea. This type of situation requires forward deployment of nuclear weapons and increased readiness. These forces must be prepared to respond quickly to massive surprise attacks. Deployed Marine forces are normally committed after a period of increased tension or open hostilities. The command and control problems concerning release of nuclear weapons during these periods should be less severe than those associated with responding to surprise aggression in Europe or Korea.

Another area of difference is the security of nuclear weapons.

In addition, we are not responsible for providing nuclear weapons for

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delivery by allied forces. This reduces the problem of providing security for nuclear weapons stored on foreign soil. Nuclear weapons will be deployed with Marine units when required. If weapons are not deployed, increased readiness can be achieved by off-shore storage in aircraft carriers and ammunition ships.

I covered this background information in order to provide a better appreciation of our requirements. This philosophy influences Marine Corps nuclear weapon development requirements in areas such as yield, complexity, etc. With this in mind, I will discuss these requirements.

Development Requirements

As we see it, the primary requirement is for modernization of the tactical nuclear weapons stockpile. Current technology will allow significant improvements in the capabilities of these weapons.

Nuclear artillery projectiles for the 155 mm and the 8 inch howitzer, ballistically matched to a conventional HE round, are required. In addition, the projectiles should have selectable yields for better flexibility and should not require field assembly.

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The Phase II Feasibility Study has been conducted, so this is well on the way. The Marine Corps has completed an evaluation of the various proposals, and the results are being sent to the appropriate Army and OSD offices.

There is little difference between Marine Corps and Army requirements in the matter of desired yields for the improved 8 inch howitzer projectile.

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The additional flexibility provided by this yield is desirable, and the increase in cost should be very slight.

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As with the ISS, we have evaluated the Phase II proposals and the results are also being sent to the army and OSD.

There is no current Naval gunfire nuclear capability. The Navy has recently expressed an interest in an 8 inch nuclear projectile and is examining the feasibility of utilizing the improved 8 inch howitzer projectile in a new lightweight 8 inch weapon system. The Marine Corps supports this program.

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A nuclear Naval gunfire capability would provide a responsive and accurate direct support weapon without the in-country storage problems associated with artillery weapons prior to first release. It would also complement air-delivered nuclear weapons in support of amphibious assaults conducted in an active nuclear environment.

The difference between Army and Marine requirements for ADM's is primarily due to the operational environment. We are not faced with critical release times and do not envision prechambering in cold war situations or deep burial. Both of the current ADM's have significant shortcomings which reduce their effectiveness. A single ADM should be developed to replace the current ones. This new ADM should:

1. weigh a maximum of 60 pounds, 40 pounds desired.
2. have neutral buoyance in salt water.
3. have a remote option.
4. not be complex.
5. be capable of burial to a minimum of 15 meters.
6. have a capability for multiple simultaneous detonation.

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Assignment to an ADM team is not a primary duty in the Marine Corps. In addition, we will probably employ ADM's in moving situations with very little time to prepare the emplacement site. Therefore, a single, simple, lightweight ADM that is one-man portable offers significant advantages.

There is a requirement to improve the accuracy of air-delivered nuclear weapons for close support of tactical operations and engaging point targets. An air-to-surface guided missile with a standoff capability similar to that of the Condor appears to be the best option to provide this capability.

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Future Technological Goals

As for the future, the Marine Corps continues to support research leading toward reduced weight of nuclear warheads, clean weapon technology, very low yields < 20 tons, directed effects, and elimination of limited life components.

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Question and Answer Period

COGGAN (North American Rockwell): How much tactical study work have the Marines done regarding different beach tactics using nucs—particularly as regards the dispersion of the attacking force and so forth which might then relate back to technology as far as landing craft are concerned?

MURTLAND: As far as I know, we have done very little study on that; in fact, probably none. We have worked with the Navy at NRDL, and they were doing some research studies on the effects of the various beaches, for example, the composition of the sand, residual radiation, and things like that. As far as I know, we haven't really correlated this with landing craft.

COTTER (SLA): Do you have any opinion on the amphibious operations when the opposing forces have tactical nuclear weapons?

MURTLAND: We would be required to have greater dispersion, of course. Say we have a division landing—our current thinking now is to have two of our regimental landing teams go in by helicopter and one to make the sea assault. Of course this would be critical with the helicopters, because we don't want a helicopter in the air when a nuclear burst goes off.

CARNE (RAND Corp.): My question has to do with your point about the use of ADM's in moving situations. I believe all the prior discussions had to do with the use of ADM's to create barriers or obstacles. Could you expand on that a bit, as to how this would work, and who would use them, how and for what purpose?

MURTLAND: Our ADM's are with our Engineer units. We have what we call Force Engineer Units, the equivalent of the Army Corps of Engineers, and they have the ADM capability. They might use it, for example, for blocking a pass to create an obstacle to the enemy. If we ourselves encounter such barriers, or if we are making an amphibious landing, we rely on our Navy friends, the UDT people, to blow out obstacles that can't be removed with conventional explosives. The UDT people use a small device—Saturn is what we have now—to accomplish this.

WHITTAKER (USEURCOM): I seem to recall a proposal for Lance whereby it would be used in some kind of LST load to support the Marines. You didn't mention Lance. Is there no interest any more in it?

MURTLAND: The Army version of Lance, which the Army is planning to use on land, is definitely of no interest to the Marine Corps. But we do have an interest in a landing force support weapon—they call it Sea Lance, and I have to let my Navy friends discuss that, because right now I don't know the status of the program.

(SPEAKER UNIDENTIFIED): Since the Marines have occasionally been in a position of defending islands rather than taking them, I would like to ask if they have examined the role that sea-borne ADM's might play in defense against a shore landing.

MURTLAND: Well that's a good point, but I can't answer that question. I don't know what tactical planning they have done along these lines.

REP. HOSMER: Is there anything with a particular characteristic or for a particular purpose that you, as a man in the field, would like to see developed and put in the stockpile?

MURTLAND: You mean, from the viewpoint of a ground Marine, anything we would like to have that we don't have now?

HOSMER: That's correct. Most of the ideas come from the laboratory and then have to be sold to the services; perhaps the services might have an idea of their own.

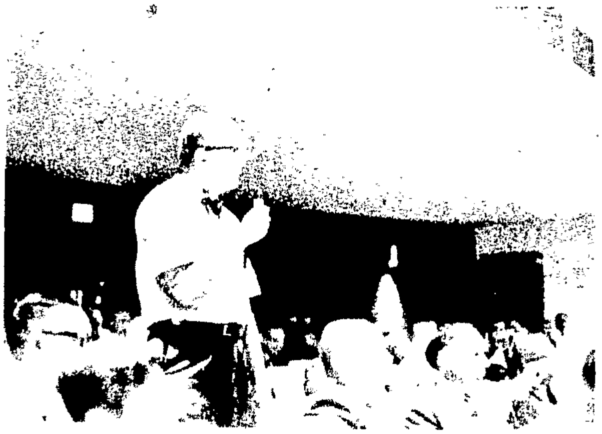
MURTLAND: I think we need something with a smaller yield that can be used in a tactical situation—for example to eliminate bunkers, caves, etc., without blowing up the whole countryside. If we could have a very low yield weapon that we could launch like a bazooka, we would really be interested in that type of weapon.

TATE (OASA): With regard to your comments about an improved 155 mm shell, would you expand on your comments about the XM179 and 198?

MURTLAND: At the development center where I work, the artillery people have informed me that the parameters of these new howitzers that they are developing out at Weapons Command, Rock Island, will be too strict for the XM454. Now I don't have the parameters at my finger tips, but that is what I have been told. Somebody from Picatinny or WECOM might have additional information.

BURKE (AMC): Your answer is correct; the acceleration levels in the 179 are much higher than in the M109. The XM454 will not take it; however, the new 517 projectile is being designed to live in both environments.

AGNEW: I believe the g-level he's talking about is about 14,100 isn't it?



Richard B. Foster
Stanford Research Institute

NATIONAL COMMAND AND CONTROL REQUIREMENTS FOR DELIBERATE SELECTIVE CONTROL RESPONSE STRATEGY

I think I have the distinction of having the talk with the longest title on the program. I'm going to review today some old studies and some of their findings and conclusions; some were done in 1960, 1962, and 1963. They might be instructive, because the problems are the same (in some ways they've gotten worse), and yet the technology has not been the critical factor. The problem seems to lie somewhere else. I'm suggesting that it might lie in our strategic thinking, in our lack of a strategic concept of operations that's both coherent and can be agreed upon by our allies and ourselves. When I mention deliberate selective and controlled response policy, I mean deliberate in the sense that we deliberate. But you don't have to deliberate after an event, you can deliberate ahead of time. We do too little of the latter. And I mean selective in the sense of selective response to aggression. Again, much of the selectivity can be thought through ahead of time, in an attempt to control events in a military or semimilitary operation, or an operation that might go from a crisis to a limited military operation. The attempt to control by personal intervention—as, say, controlling specific destroyers on this and that in order to limit the risk of escalation—is an impossible task. That's completely and finally self-defeating.

Many people advocated the pulling out of tactical nuclear weapons from Europe. I was there in 1963, and some of our people felt that they should be pulled out as rapidly as possible in the conventional emphasis strategy. But lacking that, the policy was changed. The conventional emphasis strategy was promulgated and became a territorial attitude not only to our allies, but toward the Russians, and even though the number of weapons increased in absolute numbers the ability to use them selectively declined dramatically. In other words, the tactical deterrent effect of tactical nuclear weapons began, I think, to be degraded. In this sense, "control" meant to lock up the weapons as in a PAL. I use "control" in a very different way, not as control through doctrine, but a concept of operations to control an opponent's behavior. **DELETED**

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More likely, about three or four hours later the SACEUR would be getting messages that some event had happened somewhere. His counterpart in Russia would be hearing about the same thing. Both of them would wonder who's doing what to whom, and SACEUR would attempt to obtain more information and pass it on to the President. Both commanders would be quite concerned as to who had the accident, if that's what it was. As Herman Cohen said, the problem of getting a president to push a button to go to general war or to get someone in Russia to do the same thing is quite a difficult one; it's just unlikely that you would go around pushing buttons that would doom your nation to suicide. There's a lot more stability than we give credit for in this situation.

The name of the game, I think, is the question of strategic thinking of deterrent policies and objectives and the control of the enemy's behavior.

The idea that an "assured destruction only" strategy in retaliating to direct attack on the US by striking the other's cities would provide a basis for stability of mutual deterrence and eventual reduction of arms for the Russians is not working. The Russians' strategic thinking is going in quite the opposite direction. They are increasing their options; they added counterforce capability step by step; they found holes in this mutual suicide pact and they are not about to sign it; they have not given up their civil defense program nor their air defense and ballistic missile defense program, nor have they given up the whole concept of nuclearization of their force.

Secondly, the notion of the firebreak and the concern with automatic escalation is optimistic. The Soviets' strategic doctrine, their tactical doctrine, and their political-military doctrine all stress the continuity force. One won't find a firebreak theory here. They have no concept of automatic escalation; they have a great concern of how to control escalation in their interest.

There is also the notion that "no political power derives from nuclear weapons in a state of nuclear parity." The Soviets' strategic doctrine states that all political power derives from nuclear weapons and forces, and that parity is probably a transient state between inferiority and superiority, and rather than being stable, is highly unstable, and is perhaps dangerous rather than safe. And besides, they take into account the real world complexities of the definition of parity. How does one take into account the asymmetries of geopolitical position—the closed line of communication with the Soviets' armies in Europe and in Asia, the asymmetries in the ways of allocating resources, and their controlled economy in which they also control their population? Their debates apparently take place in a much smaller and less public arena, with far fewer people involved. How does one, in that state of affairs, define a stable state of parity? Some say that there's no meaningful definition of strategic nuclear superiority. In a sense, strategic superiority is that which gives you one or more degrees of freedom over your opponent. It has nothing to do with absolute superiority. The argument here is that these are relative things and the degree of freedom is important. In a sense, the Soviets have not given up the idea of increasing their degree of freedom in the full spectrum of conflict in a concept of continuity force, and hence the reasoning that nuclearization therefore is not in the opposite direction.

One of my former colleagues, who became an official, said that we couldn't improve our relative posture with an addition of $10 billion—that we were buying all that money could buy. Well, the Russians didn't quite believe that either. On an average, they've increased their total national security budget 5% per year; their strategic nuclear forces budget, offensive and defensive forces, 8% per year; and their science and technology budget, over 10% per year. The Communist Party, nonmilitary hierarchy must consider very peculiar our statement that we can reduce the risk of escalation by a conventional emphasis. Well, it is true, we've deterred major wars, nuclear wars between Russia and the US, and local wars in Europe. We now declare the just wars—national liberation, revolutionary wars, and class wars. The Russians accommodated us in Vietnam, and this accommodation led, in part, to making it very difficult for a president to get reelected. So I doubt if this particular strategy is going to be adopted by a president in the future; it means he gets into wars he doesn't know how to stop; he's accommodated by the Russians. Another part of the optimism is that a detente occurred, and this detente was such that they would help us out of Vietnam at a 25 to 1 exchange ratio.

I happen to have a pessimistic view of the Soviet behavior. I'm much more concerned about their long range trends and their expenditures, which we have traced back to the 50's. We have noted their long range commitment to political and military strategic goals, their long range patience in overcoming handicaps of technology due to a poor economy. They have created three economies: economy 1 is the agricultural, the poor one; economy 2 is a consumer goods economy, slightly more prosperous; and economy 3 is a first class military and industrial complex, scientifically and technologically based.

I bring this up because, before we can talk about a deliberate selective control response policy, we should know where we stand. Some predictions were made, some 6 to 8 years ago, that the US would suffer certain consequences of not rethinking its fundamental strategy and doctrine in deliberating selected control response policy. The first consequence was that we gave up any attempt to challenge local Soviet strategic superiority in Europe. We have nothing to counter the MRBM/IRBM combination. They have the capability of disarming, seizing, and occupying a relatively intact Western Europe, using a policy of restraining and minimizing collateral damage and fallout.

We have updated our 1960 calculations, and they still run about the same. They can launch such an attack at 200 to 600 aiming points and—depending again on the criteria used for kill requirements, insurance levels, and assumptions of CEP and accuracy of fuzing—we get a range of uncertainty of population fatalities of 3 to 10%, of collateral heavy damage to industry of not greater than 9%, and light damage not greater than 10%. That's a relatively intact Western Europe.

When I was in Europe in 1963, arguing the case for and against the MRBM, the principal argument against it was the fear that it might be seized. There's no good inexpensive way of protecting it from seizure. This was a political discussion of the problem that had nothing to do with the usefulness of this type of weapon. One of the reasons the MLF was looked upon with favor wasn't so much its survivability as that it was harder to seize and occupy and use.

Now if the Soviets have that superiority, one of the holes in our doctrine and one that concerns the initial use of tactical nuclear weapons, is the following: Suppose the Russians do not think that we have decoupled our strategic deterrent from the umbrella protection of Europe, but instead attack simultaneously Europe and the US counterforce, avoiding cities and holding a large strategic reserve. They have simultaneously evacuated their cities, since they know that, if we do retaliate, they are going to get a considerable amount of damage. Their recovery from attack could be assisted by the European economy which they have disarmed, seized, and occupied. The US has so configured its force that it loses more and more degrees of freedom of retaliation; it can only retaliate on Soviet cities; it can't retaliate with second strike counterforce. Thus a very interesting thing comes up. They leave the president alive, say. Russia says, "Your cities are alive because mine are, and the moment you retaliate on mine, you lose yours, and you haven't evacuated, and I have Europe." Now, I'm asking you, would you retaliate? I suggest that the Russians are outthinking us. They have clear guidance with respect to their goal—it's to get meaningful superiority that gives them a greater degree of freedom than we will have.

Another way of getting conventional emphasis is by proxies against your proxies, for example, the Arabs against the Israelis. After a while the nuclear umbrella doesn't seem to work; that is, the Israelis may lose confidence in our guaranteeing their survival and have a lot more interest in getting a nuclear weapon of their own. We can't have it both ways. We can't have a doctrine, a strategy, which in effect says that there's little if any strategic utility in nuclear weapons and then expect the nonproliferation treaty to work. The strategic utility of nuclear weapons has to be positive for anyone to have confidence in your nuclear guarantee against nuclear coercion and blackmail by the other side. Now the Russians understand this; they write about it very well.

One of the concerns in Europe is really not just the massive overrunning of Europe, but the problem of a quick penetration for limited objectives, as, say, in the Turkish-Thracian peninsula. We have an excellent example, in the Soviet occupation of Czechoslovakia, of the limited aggression for limited objectives, with rapid envelopment both vertical and on the ground. Apparently one of the reasons it was unopposed was that the Czech military estimated that they would probably not be very effective against that force that poured in so rapidly.

I doubt very much if these limited aggressions for limited objectives would fit the optimistic assessment of Soviet policy and behavior I've outlined before. So I think that, before we can get a clear set of guidelines to develop a doctrine for the initial use of tactical nuclear weapons, we have the fundamental problem of overhauling our strategic thinking from top to bottom, taking into account the fact that the Russians are doing a very effective job. I commend to you the first, second, and third editions of Sokoloski's Military Strategy, and the writings of Rimkin and Von Rinco from the Lenin Institute. In these writings you will find no suggestion of discontinuity of force, but rather stress on continuity.

We have some advantages left. We have, certainly in my view and that of Dr. John Foster and others, considerable advantage in certain areas technologically, but we are not exactly using it—for example, the possibilities of controlled use of tactical nuclear weapons inherent in the WISP Program; the possibilities of quick use through predesignation, not predelegation; the possibility of a tactical concept in which the initial use of tactical nuclear weapons is broadcast widely. If the conditions under which they would be used were spelled out to the Russians, it is still possible that this would have a decisive deterrent effect on his tactics. If you have a graduated deterrent from the strategic nuclear down to the 1 kt tactical nuclear weapon at the FEBA, it has to be known before it will deter. An unknown doesn't deter very well.

It's not too complicated to figure out that the optimum tactics for a successful penetration by a land army is to mass, to break through the defenses by surprise, in one or more areas, and move fast with close air support. In one to three days the Russians would be in England. So let's talk about 1 to 3 minutes and 1 to 3 hours. Now we can have a decisive coercive effect on Soviet tactics by saying, "If you give me a target over my political border that's worthy of a nuclear weapon, I'll hit it; and here's a list and array of the kinds of targets I'm talking about." That's all you have to tell him. It wouldn't be a bad idea to have sergeants with weapons that couldn't hit Moscow, but could hit a target like that. It would have a more decisive deterrent effect.

By doing the opposite, we are giving up the deterrent effect and inviting risks that the opposition will take, thus inviting additional risks. This notion that we are being self-deterred because of the risk of escalation, that a defender will use a nuclear weapon initially against an aggressor, assumes that there is asymmetry and parity between aggression and defense. It assumes secondly that the risk of escalation should be removed from an aggressor. Well, the whole point of stable mutual deterrent posture is that the aggressor will be met with the risk of escalation. If you don't escalate, and he adduces it to be a low risk, he'll move, as the Soviets did in support of Hanoi. A low risk alternative to nuclear war of any kind, and a very good one in terms of the trade-off, it has had all kinds of interesting side effects and benefits from the Soviet point of view. In addition to getting presidents diselected, it tends to cause a considerable amount of disruption within our country, in the students' rebellion and the work of the SDS, for example.

The Russians aren't in any rush, I don't think, to enter the SALT talks until they find out from what floor we'll negotiate, and we haven't hit our floor yet. You see, I don't think that last $3 billion cut is the final one. So why start negotiating until your opponent has put his price of entry into the game? We are lowering our price so that he doesn't have to pony up as much on the table. I suggest that this might be one of the reasons that they're not quite ready. I don't think that this behavior is so mysterious. They're people who are interested in their power, and in extending their power.

Now I'm suggesting we have a bit of a problem in deliberate selective control response. We can't readily undo the fact that the Soviets have in fact gone ahead with over a thousand ICBM's, including the SS9/SS11 mixture; and they have increased heavily their investment in both the attack submarine and the Polaris type. I'm suggesting that it is going to take some time for the US to rethink its posture, and to get back a concept of continuity, not discontinuity, of force; to get back an idea of what risk of escalation should really mean, that you want the aggressor to risk it. If he doesn't risk it, then he'll exploit local superiority, conventional or otherwise. And so I say that's the first job. A second job is to investigate what can be done with predesignated situations for initial use of weapons. A third is to work out a notion of the deterrent's coercive effect on tactics.

What is the deterrent effect of an ADM? I remember talking to a Turk in 1963, and he had a very good idea of the deterrent effect of an ADM. I said "That's your own territory and it might get kind of messy." He replied, "That's true, but it will make it messy for the Bulgarians, Rumanians, Russians, or whoever else comes over that area." Well, I understood that Turk better than I understand this optimistic appreciation of the Russians.

And finally, we should reconsider the question of what command control really means. What is command? Well, to a large extent, it is simply thinking things through. Figure 1 suggests one possible meaning of command control. We certainly want to centralize command. Command is that which initiates, prescribes the extent of, limits, assesses, the direction of a military operation. Command is, at the top level, largely political. Much of this can be accomplished through prethinking, predeliberation, preselectivity, and prenotions of limiting and controlling. You set control here by doctrine to a large extent. National command retains its control center, control of our offenses in general nuclear war, and I think that's only sensible. But the control problem should be delegated as far down as possible to supervise, regulate, and coordinate, so as not to try to run the war from Washington.

COMMAND CONTROL

Centralize

COMMAND — INITIATES, PRESCRIBES EXTENT, LIMITS, SETS DIRECTION

BUT COMMAND MUST RETAIN CENTRAL CONTROL
OVER OFFENSIVE FORCES IN GNWAR AND BE
ABLE TO PREEMPT CONTROL IN ALL SITUATIONS

Decentralize

CONTROL — SUPERVISES, REGULATES, COORDINATES

Figure 1

Our national goal is, of course, national survival, but we equate national survival with not letting the Russians have Western Europe. So you provide for civilian command of forces, eliminating mechanical doctrinal response to any kind of offense and providing for maximum flexibility of choice of action by decision makers. But the civilian command means also the possibility that we can reach an agreement with our principal allies, as I believe Mr. Shreffler pointed out yesterday. Flexibility of choice of action doesn't mean a conventional emphasis or a nuclear emphasis. It means precisely what it says—you have worked through your doctrine and your understanding of the situations and are keeping them up to date. You keep thinking them through so that those choices are truly open choices without an emphasis. This leads to adaptability to unforeseen contingencies anywhere in the world. Many of these contingencies have been blown up way out of proportion, as if somehow they will blow up into a general nuclear war. Well, perhaps; but in most cases they seem to stretch out for quite a while, as Vietnam has.

Let's take a look at one of the concerns of the President of the US as he is thinking about initial release of tactical nuclear weapons—the vulnerability of this country. I made a chart back in 1961 and it's still true in 1969 (Figure 2). This happened to be President Kennedy and his successors subjected to a 10 megaton or a 2 megaton burst, and the middle is 100 psi. This is one weapon. These people tend to be vulnerable; the President has to be out there in front, he can't abandon the leadership of the country and go underground. It's not unthinkable that command itself would be attacked in an attempt to get a cheap victory by beheading the command of a nation. History shows that it's been tried before, and the Chinese tend to be quite interesting historians. There are other reasons why national command might be attacked, but I'm pointing this out because of the vulnerability question.

Vulnerability of Presidential Successors

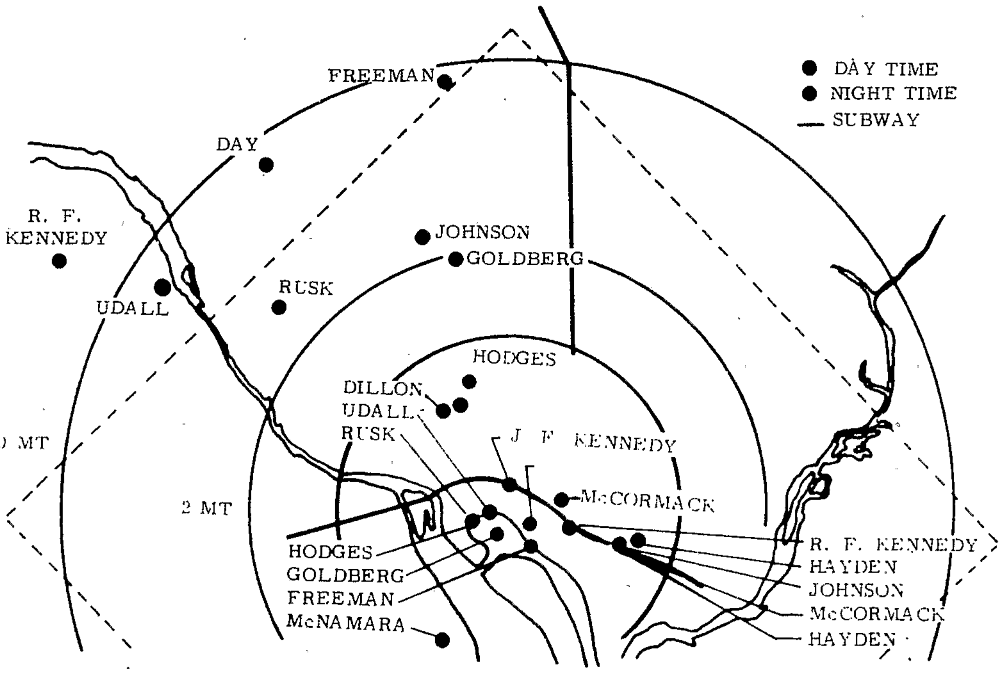

Figure 2

One of our problems is almost a complete lack of a doctrine for the continuity of the office of the President. There is much better doctrine for continuity for the Commander of a Division than for the President as Commander in Chief. One of the possibilities suggested in Figure 3 is the little model presidential party. You have a small party of ten, with a few personal staff for continuity of command and a second group forming the support party. This whole party could be trained in some doctrine or other. But what doctrine do we train them in? What is our doctrine? As I mentioned, there is one under development in the Soviet Union, and it's a very helpful thing to have. Figure 4 shows how such a concept might work for increasing survivability, and it has some interesting points in the tactical situation or in the situation in Europe. In this case we have the model presidential parties going to several different occasions, the circles, and the needlines are intermitted to find out who's "on first," whose man is president, and who's the highest living ranking successor. You have another set that ties them together with Europe, UK, CINCLANT, CINCEUR, unified commands, and finally the groups equivalent to the FREE's, the recoordination centers in Europe and in the Pacific. But such a concept for survivability is based on a sort of relocation, and it requires a considerable amount of preliminary thought.

PRESIDENT (OR DESIGNATE)

	REPRESENTATIVES OF:	
Main Party (1st Echelon)	(a) State Dept.	(1)
	(b) CIA	(1)
	(c) OEP	(1)
	(d) Defense Dept.	(1)
	(e) JCS	(5)
	–Chief/Staff	
	–J-2	
	–J-3	
	–J-4	
	–J-6	
	No More Than	(18)
	REPRESENTATIVE OF:	
Support Party (2nd Echelon)	(a) Treasury	(1)
	(b) Attorney General	(1)
	(c) Interior	(1)
	(d) Agriculture	(1)
	(e) Commerce	(1)
	(f) Labor	(1)
	(g) HEW	(1)
	(h) AEC	(1)
	(i) FBI	(1)
		(9)

Figure 3

MINIMUM ESSENTIAL NEEDLINES TO 1965
BASED ON CURRENT CONCEPT OF OPERATIONS
(EXTENDED BY SRI)
FOR PRESIDENTIAL FUNCTION OF NATIONAL COMMAND

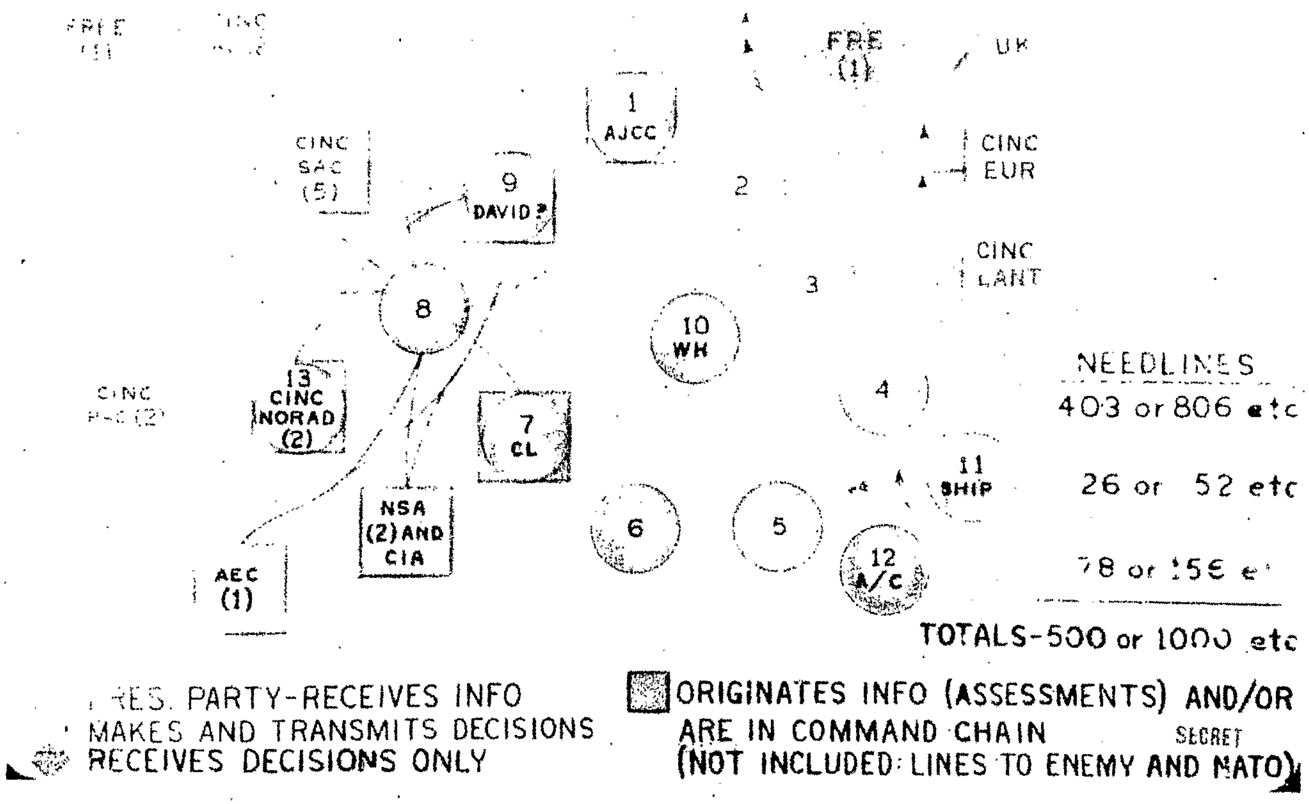
FREE (1)
CINC
FRE (1)
UK
1 AJCC
CINC SAC (5)
9 DAVID
2
CINC EUR
CINC LANT
3
8
10 WH
13 CINC NORAD (2)
CINC PAC (2)
7 CL
4
11 SHIP
NSA (2) AND CIA
6
5
12 A/C
AEC (1)
NEEDLINES
403 or 806 etc
26 or 52 etc
78 or 156 etc
TOTALS-500 or 1000 etc
PRES. PARTY-RECEIVES INFO
MAKES AND TRANSMITS DECISIONS
RECEIVES DECISIONS ONLY
ORIGINATES INFO (ASSESSMENTS) AND/OR
ARE IN COMMAND CHAIN
SECRET
(NOT INCLUDED: LINES TO ENEMY AND NATO)

Figure 4

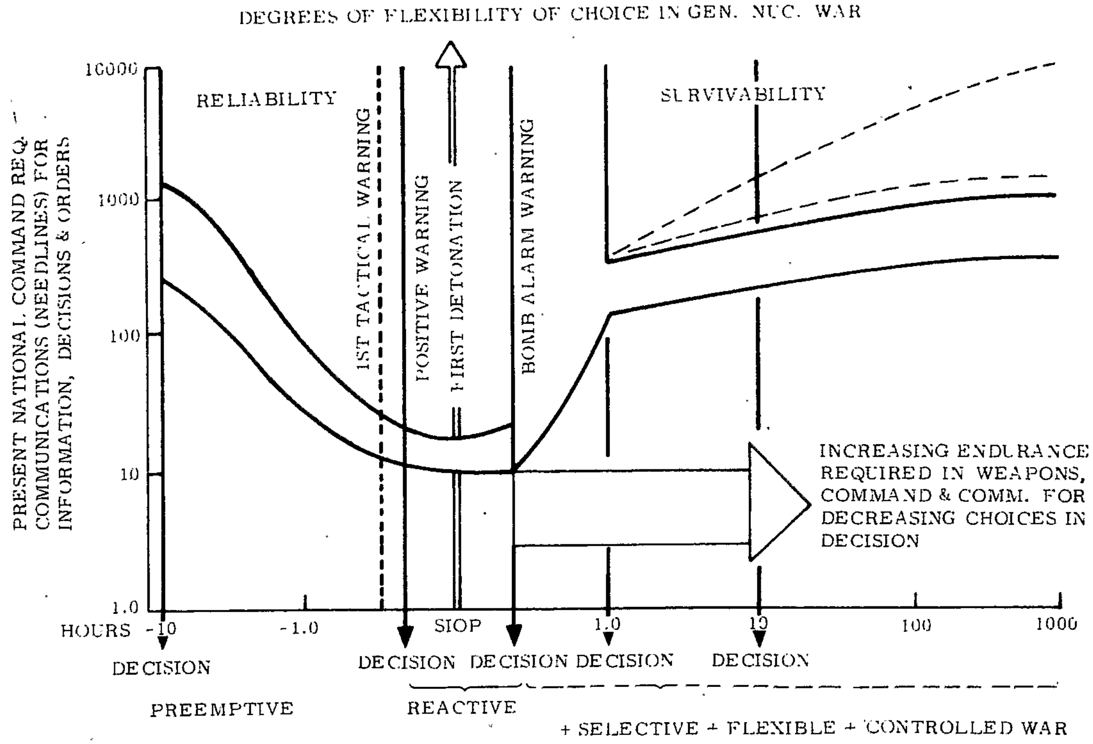

Figure 5

Figure 5 shows how this might look as a function of needline requirements on the national scene. Here on the ordinate is the number of needlines required; and along the bottom is a zero point which is SIOP—in this case a first detonation; and to the left of that first detonation are decisions made ahead of time. You might have a preemptive decision made 10 hours ahead of time, and then other decisions made sequentially, and yet I have shown here two doctrinal responses requiring the least information: One is based on a sort of "fire on warning;" you see enemy missiles coming on your radar scope, and you fire your missiles before they hit. The other is "fire on bomb alarm" with no assessment, but it's an automatic assessment system through a computer and your retaliation then becomes doctrinal. This carries things too far. You need a minimum needline—we estimate about 10—for that. But, as you get more and more responses and more and more reserves, if you attempt to fight a control war out to the hundreds or thousands of hours, you have an increasing value to command; that is, the commander himself and his ability to control forces; increasing requirement for survivable intent; restorable needlines and communications; and ability to control the conduct of the war termination.

One of the things that is lacking in our current doctrine, to a large extent, is the problem of war termination. Those who were eager about getting the war started in Vietnam didn't seem to have a clear idea of how to stop it. If you are going to start a war, you had better figure out how to get out of it, especially in the event of a general nuclear war. Because it might escalate to that, if you put the risk of escalation in the other fellow's way. He might take you up on it and himself preempt. But, generally speaking, the more prethinking that is done, the less need there is to have an enormous amount of information at the presidential level for initial release of a tactical nuclear weapon.

Figure 6 shows the command control requirements in the theater. First, there would have to be consensus among the political leaders and the military commanders as to the strategic concept, the deterrent effect you are striving for, with commonly understood rules of engagement. There would have to be a command center for CINCEUR, since he has a continual responsibility in the selective release; a warning and alerting system specifically designed for recognition of the situations in which you might want a first nuclear detonation, say a 2 kt weapon; and an independent, timely, adequate presentation of the situation with an independent means of verifying it. In the event that presentation of the situation was by an allied force, you would want a US pilot to fly over and verify it for CINCEUR. A most useful concept for such verification is a common theater reporting system between Army, Navy, and Air Force. We don't have that now; worse than that, we don't have a common system between the US and its allies. An automatic data processing system with an adequate data base is required. I put that in more to satisfy some of my colleagues who are very happy with computers, but I remind them that if you don't have a very clear conception of what you want to do, an enormous amount of data being ground in and out of a computer is just confusing. But this would leave CINCEUR in the theater in communication with JCS and the President and the Secretary of Defense, with a positive control of all weapons with the selective release proceduring system, selective, enabling, and communication.

COMMAND - CONTROL REQUIREMENTS

1. CONSENSUS AMONG POLITICAL LEADERS AND MILITARY COMMANDERS
2. COMMONLY UNDERSTOOD RULES OF ENGAGEMENT
3. USCINCEUR COMMAND CENTER
4. WARNING AND ALERTING SYSTEM
5. TIMELY AND OPERATIONALLY ADEQUATE PRESENTATION OF SITUATIONS
6. INDEPENDENT MEANS OF VERIFYING SITUATION
7. ADEQUATE COMMUNICATIONS
8. COMMON THEATER REPORTING SYSTEM
9. ADPS WITH ADEQUATE DATA BASE
10. POSITIVE CONTROL OF ALL WEAPONS BY USCINCEUR
    - SELECTIVE RELEASE PROCEDURES AND SYSTEM
    - SELECTIVE ENABLING (PAL)
    - USCINCEUR IN DIRECT COMMUNICATIONS
11. ADEQUATE SURVIVABILITY

Figure 6

Adequate survivability does not have to be against a 100 megaton weapon. The Soviets are unlikely to use large yield ground burst because prevailing westerlies would bring radioactivity back on them. They would be very likely to have a policy of restraint, and they increasingly talk about it. So adequate survivability, in my opinion, involves minimizing collateral damage. This policy of restraint is achievable.

Figure 7 shows the levels of force application. Level zero is the period of mounting tension, warning, alerting. Level 1, armed conflict, brings initial conventional defensive response; now that might be within one minute, not one or two days. You don't try to contain an attack that is obviously beyond your resources to contain. There should be no concept of a prolonged war in scope and time between NATO and Russia in Europe; but rather we're talking about a deterrent situation in terms of trying to get the opposing force to realize that he does risk a series of escalations if he persists: the defensive use of tactical nuclear weapons in his own political territory initially; then (here would be the predesignated cases of the "eyeball" type weapons that can't be delivered on Moscow) localized battlefields beyond the political border, as discussed this morning by Colonel Page; operations in the satellite countries; and finally, the controlled strategic nuclear operations in a general war. One of the things that's interesting about technology is that some of the controlled strategic nuclear operations could be put into a level 6, and level 5 would become strategic nuclear forces engaged in support of the theater. The technology permits it with the MIRV on the Minute Man 3 or an advanced ICBM or Poseidon.

LEVELS OF FORCE APPLICATION

Level 0 - Period of Mounting Tension - Warning and Alerting

Level I - (Armed Conflict Begins) Initial Conventional Defensive Response

Level II - Defensive Use of Battlefield Tactical Nuclear Weapons on NATO's Own Political Territory

Level III - Tactical Nuclear Weapons in Localized Battlefield Beyond the Political Border

Level IV - Tactical Nuclear Operations in Satellite Countries

Level V - Controlled Strategic Nuclear Operations in General War

Figure 7

TYPE SITUATIONS

- To Eliminate a Penetration
  - Seal Off the Penetration
  - Prevent or Impede Enemy Reinforcements
  - Provide Adequate Fire Support for Mobile Reserves in Counter-attack Role
- To Hold Critical Terrain
  - Destroy Enemy Forces in the Attack, Particularly when Friendly Reserves Are Not Immediately Available
  - Prevent Enemy Reinforcement
  - Deny Use of the Terrain to the Enemy in the Event that the Enemy Has Already Captured Critical Terrain Features
  - Deny Enemy Use of High Speed Avenues of Approach (Passes, Defiles, Corridors, etc.) into Defended Areas
- To Minimize or Preclude Air Attack

Figure 8

Figure 8 shows the types of situations that might be of interest. These can be much more carefully worked out. We found, even in 1963 with just a few officers and civilians working on a scientific military team, that there was a great deal of information that needs organizing around some concept. If you don't have a concept, you have an infinite amount of data to pull together and it doesn't do you any good. The types of situations as indicated in Figure 9 will also help you set basic limits for the employment of tactical nuclear weapons.

In summary, I suggest that a national, deliberate, selective control response policy is a feasible one, but it will take a fundamental review of strategic concepts and of our appreciation of the Russians; some balanced conventional nuclear forces with a nuclear emphasis in areas of high political value like Europe; and preselected levels of force application, skipping those where the opposition has the advantage. I have to skip for some indeterminate time the theater strategic nuclear exchange where the enemy has the advantage with the MRBM or IRBM, but again I mention that that might be overcome with a new advanced technology inherent in the MIRV and very good accuracy and selective use. We will also have to decide on distribution of classified tactical nuclear weapons, rules of engagement and criteria for use, particularly for first use—distribution throughout the ACE force with selective release procedures based on a concept of predesignation. Now, with this having been thought through and a great deal of this becoming embodied in doctrine, the command control system becomes a problem that is possible of solution, insuring timely and controlled employment of tactical nuclear weapons when necessary to supplement or to execute the strategy. In the present melee of concepts, I do not believe we have a possibility of a command control system that will work in Europe for the selective release of tactical nuclear weapons. But I do believe it's possible to think the thing through. We will have to work hard to overcome the deterioration of our deterrent position through at least 1975 or beyond, because we have lost the cutting edge of some degree of strategic nuclear superiority over the Russians.

BASIC LIMITS FOR EMPLOYMENT OF TN WPNS

- Geography (by level and relation to political boundary)
- Classes and Yields of Weapons
- Numbers of Weapons Released
- Types and Classes of Targets
- Constraints as to Collateral Damage and Fallout
- Political Constraints of Host Country

Figure 9

The Russians did not behave the way we expected them to, and the danger inherent in this can be described as follows: An aggressive expansionist nation that's increasingly well armed gets more and more convinced of the correctness of its strategic concept. It begins to think that it's winning and that the opposition is losing and tends to get somewhat reckless. This nation will take political risks that were unthought of several years ago—witness the strategic risk of the Khrushchev missiles in Cuba. The Russians did not sympathetically parallel us going down in strategic force capability, in the "sure destruction only" strategy; they went the opposite way, they went up. The dangers of Soviet aggression or Soviet aggression by proxy in the early 70's might actually increase if they thought that the risk of escalation had been radically reduced or removed for many actions. If they thought that our unilateral arms limitation policy would have a destabilizing effect rather than stabilizing at lower levels and reducing costs, they might be tempted to take unprecedented risks.

Question and Answer Period

COGGAN (North Am. Rockwell): I detect a great deal of emphasis on what we see in the writings of Soviet military leaders regarding their strategy and doctrine. I would suggest that their military structure is probably influenced by the non-military features of their government structure much more than ours is, and therefore considerable attention should be given to that feature in determining what they might do. What I'm saying is that the military leaders of the USSR will not play as important a role as ours do in deciding on a course of action.

FOSTER: Well, at best, that's a disputable statement, I think, sir. The Russians are a very interesting people. Obviously they are different from us and they have a somewhat different way of organizing their business. They think of Marxism and Leninism not just as idealogies, but also as sources of political guidance and scientific insight into history. And so they have a Lenin Military Academy as a part of the Ministry of Defense, but run by the Communist Party. This ties together the Party's concepts and the military. They also have the Fremzo Military Academy, where they study tactical doctrine and strategic doctrine, closely supervised by their policy makers. It's also interesting to note that many members of the Politburo and the secretariat of the Party are also reserve military officers. The first priority of the Party has been, and is still, the power of the state—not the welfare of its citizens as we think of it. The power of the state is expressed not only by the KGB that helps order the people through secret police repression, but also by how they order their affairs in the outside world. As we look back at the decisions they have made, we find a very high correlation between the weapon development decisions, deployment decisions, and the development of their strategic doctrine. This can't be entirely by chance. Besides, the military does rather well; their budget keeps going up at 5% per year, among other things.

TRYBUL (AMCA): John Foster recently predicted a technological superiority for the Russians, but he did mention that the US will maintain technological superiority in the areas of nuclear energy and space; he does, however, foresee technological surprises in the new weapons development in the very near future. Am I correct in assuming that your remarks tend to confirm or support these statements?

FOSTER: The answer is not only "Yes" to that, but if the Soviets do keep on increasing at the current rate for their RDT&E, 8 to 10% per year, they will exceed us by 1975 in our military and space program by a factor of 2 annually. Somehow, the idea that they're only half or a third as cost effective as we are, so that we don't have to worry about the relative expenditure, doesn't appeal to me. Some of the optimists I quoted claim we'll maintain technological superiority by underspending them; but I don't think this is going to happen.

LOVE (USAF): You imply that Russia has a rather pat doctrine and all the freedoms of choice to employ that doctrine. I would submit that China is a severe strain on that doctrine at this time; and I would submit that, when Russia had to invade one of her Pact member nations, things weren't very well there either.

So I would say that her doctrine may be under severe strain, and the Russian really isn't ten feet tall.

FOSTER: May I suggest, first, that I didn't want to make him ten feet tall; I simply said that he had developed a coherent military doctrine with guidelines to both strategic concepts of operation as well as allocation of resources. The way he conducts his foreign policy related to that is a somewhat different matter. Obviously Khrushchev made an error when he gave the Chinese a lot of knowledge about nuclear matters; they turned around and bit him. But, the point I was making is that they have developed a coherent strategic doctrine and they keep at it, and they have a way of conducting an orderly debate within their society. They see the evolution of doctrine, and they adapt to changes in the international scene and in technology. It is a doctrine that everybody can read and be guided by at any given time. It is coherent and consistent, whereas I would characterize ours as incoherent and inconsistent. I think that having such a doctrine gives the Russian a strategic advantage, even if it doesn't make him ten feet tall.

M. R. Gustavson
Lawrence Radiation Laboratory

OPTIONS IN CONTROL TECHNOLOGY

Introduction

If tactical nuclear weapons are to play a more effective role in supporting national policy, new options in force posture, plans, and policy will be required. This, in turn, will require enhancement of our commanders' capabilities to control nuclear weapons. This paper is an attempt to describe some of the technology which is being developed for that purpose.

Control technology is, however, a very broad subject. It is like a chain with many links. To discuss this topic in any detail it is necessary to limit the number of links included. This paper focuses on this subject as it affects nuclear weapons, and more specifically on the control link at or in the nuclear weapon. The options available and utilized here help to determine the nature of the other links in the control chain, all of which are, of course, important in forming the complete system.

Figure 1 helps to further delimit and define the subject to be discussed. This paper is concerned with intentional nuclear detonations, i.e., where at least one person is not surprised. This is defined as the control issue. The unintentional nuclear detonation case, in which everyone is surprised, is defined as an issue of safety rather than control. This issue will not be discussed further.

Two classes of intentional nuclear detonations are of concern: unauthorized and authorized. This is necessary because both are important in effecting any change in our tactical nuclear posture. It is assumed in this paper that obtaining and retaining a posture which permits the effective use of nuclear weapons is dependent in part upon our ability to convincingly demonstrate that only the designated use will occur, that misuse is improbable. The analogy with safety requirements seems obvious.

UNINTENTIONAL (Safety)	INTENTIONAL (Control)	
	UNAUTHORIZED	AUTHORIZED
ADMINISTRATIVE	HARDWARE	POLICY
	CAPABILITIES Command Destructs Combination Switches DELETED Intelligent Systems	
	REQUIREMENTS	

DOE
6.2(a)

Figure 1

Of the several approaches to this problem—administrative, hardware, and policy—only hardware is discussed. This is the aspect most appropriately addressed by the AEC. This, of course, is not meant to deny the importance of administrative procedures, such as two-man-rule, nor of policy decisions, such as where the US will position weapons overseas.

Further, this paper is directed towards describing capability options, an area in which we have special information. At the end are a few personal comments about requirements. These may be helpful in focusing attention on the decisions which are most needed to maximize the usefulness of further hardware development.

Under capabilities in Figure 1 are listed four categories of systems. These represent an approximate hierarchy. They are ordered roughly with respect to chronological development and, also, in the sense that the later or more advanced systems frequently contain the earlier items, as subsystems.

One way of understanding a system is in terms of the task it is designed to accomplish. Therefore, before describing these systems it is useful to posit a specific situation which can be referred to in explaining some of the challenges and opportunities offered by these systems. A useful scenario is that of a field commander in a frontline situation who has as a part of his assets tactical nuclear weapons. Assume that he is facing the forces of a technically gifted, but nonnuclear power. His problem, then, is one of insuring control over his weapons so that they can be used to support US objectives but cannot be overrun and utilized by enemy forces.

Even with these restrictions the wealth of available information on hardware options is such that its full coverage is beyond the scope of this paper. Therefore, what follows is illustrative of opportunities rather than comprehensive. Many worthy contributions are slighted.

Classes of Hardware

Command Destructs

In considering command destruct systems a number of qualities are of importance. Three are of very special concern (Figure 2). Each deserves a few words. Destructiveness is best measured in terms of the ease of repair by the enemy. One can consider anything from a bent pin connector through total disruption of the nuclear assembly. Safety in this context refers to the collateral effects of the destruct system on our own personnel, their transport, and any collocated systems. Timeliness must consider installation, triggering, and completion of the destruct action.

QUALITIES OF COMMAND DESTRUCTS

Destructiveness
Safety
Timeliness

Weight/Volume/Cost
Vulnerability
Reliability
Covertness

Figure 2

Weight, volume, and cost as well as vulnerability to enemy action have obvious importance. Reliability must encompass both assurance that the system will function when triggered, as well as assurance that it will not function prior to triggering. Covertness in a situation of potential military overrun refers to the possibility that one may wish to remove nuclear capability from the field without enemy knowledge.

Command destructs can be designed in many different fashions. Figure 3 provides a general outline of the principal classes. A variety of units can be added externally to destroy nuclear weapons. General purpose military munitions have frequently been allocated for this contingency. Special externally mountable munitions (Figure 4) have also been developed for this purpose. The latter have size and designed adaptability in their favor. If properly positioned they can also be used with a high certainty that no secondary chemical explosions will result and with selectivity as to the nonnuclear components which will be destroyed. This latter is important when one evaluates destructiveness in terms of repair or replacement by an enemy.

CLASSES OF COMMAND DESTRUCTS

- External (Separable)
    - General Purpose
    - Special Purpose
- Internal (Nonseparable)
    - Nonnuclear Assembly
    - Nuclear Assembly
        - Special
        - Dual Purpose

Figure 3

As for systems internal to the nuclear warhead, a wide variety of concepts have been considered (Figure 5). These include a substantial range in terms of destructiveness and violence and involve a wide variety of components and techniques. What one would prefer, of course, is a quick acting, highly destructive system which is completely safe in the sense that there is no effect external to the weapon skin.

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DOE 6.2(a)

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DOE
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Good progress is being made despite the three-dimensionality involved in treating these problems. Certainly the system can be adapted to some, but not necessarily all, weapon designs.

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Thus there are numerous designs which can be considered for command destruct, each having certain unique properties. It is important to note, however, that the addition of internal systems on a retrofit basis limits one's choices dramatically. Command destruct capability is best not added as an afterthought.

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Figure 5

Combination Switches

This topic is familiar to the services under the acronym PAL, or Prescribed Action Link. The qualities generally sought in such systems are shown in Figure 8

Many paths can be followed in this area as the techniques of electromechanical and electronic design are applied. Figure 9 indicates some of the major options which can be considered for future generations of such hardware. Switches capable of storing several codes or of doing limited internal data processing can make possible new alternatives in selective release, code changing, and exercising.

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QUALITIES OF COMBINATION SWITCHES

Security
Speed

Flexibility
Countermeasure Resistance
Weight/Volume/Cost
Reliability

Figure 8

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MAJOR OPTIONS IN COMBINATION SWITCHES

- Multiple Codes
  - Hierarchy Systems
  - Remote Code Change
  - Exercisable Systems
- Microminiaturization
- Try Limiting Features

Figure 9

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Try limiting techniques which are designed to provide quick operation with a short correct code while decreasing the effectiveness of trial-and-error methods of gaining control also offer a fertile field. The limited try feature now being utilized for some new systems is a first start in this field.

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Multiple codes, microminiaturization, and new try limiting features can all contribute to strengthening our posture in this area.

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Figure 11

The qualities which one seeks in such a system (Figure 12) are, first of all, countermeasure resistance and environmental insensitivity.

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DOE 6.2(a)

Figure 12

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DOE 6.2(a)

Both extremes, and the middle ground as well, can only be investigated, and the system must be validated by using teams dedicated to circumvention working on real hardware.

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In many ways the solutions to this problem parallel those which have been applied in the nuclear safety area—high quality components and/or circuitry, and detailed system testing.

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They can be utilized with the command destructs previously described or with less destructive penalty modes. The several options available in combination switch technology can also be incorporated.

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Figure 14

Intelligent Systems

This section should perhaps be labeled "Advanced Systems," for many of those systems previously described exhibited a type of intelligence only quantitatively different from that discussed here. Basically, that is an ability to sense, discriminate, and act. Certainly a combination switch which recognizes a number of codes and gives appropriately different responses exhibits these features. In fact, it is the control protection which can be offered by PAL and PAPS systems, which in some cases is a logical prerequisite for adding further warhead subsystems. Another important factor is our enhanced ability to build more than one outcome into a given warhead.

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Thus one can add further subsystems to improve warhead safety, effectiveness, or control. Of the many possibilities which can be envisioned in this area only one will be discussed. This system is based on making warhead response dependent on a crucial question—namely, where is the warhead? In terms of the posited scenario, such a system might be used to preclude the use of captured nuclear weapons against US forces (Figure 17).

The primary objectives which one would like to achieve in developing such a system are shown in Figure 18. Navigation without external inputs can only be achieved with inertial systems. However, there are no such systems available today which meet the other objectives adequately. In particular, the available systems, even in prohibitively heavy (and large volume) configurations, are based on more frequent updatings and adjustments than would be logistically feasible for warhead applications of the type being considered.

To succeed, one must change those existing systems. A change might be effected by taking advantage of some of the peculiar features of the application we have in mind. One of these will serve as an example of a number of novel developments to which this program has given rise.

It should be noted that the AEC is conducting this program jointly with ARPA. Liberal use has been made of the inertial guidance technology previously developed under the sponsorship of both the Air Force and Navy.

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Figure 16

GEOGRAPHIC POSITION LOCATOR CONCEPT

SPECIFIC AREA OF USE

Figure 17

PRIMARY OBJECTIVES

- Field Operation with Infrequent Updating
- Navigation and Comparison/Response without External Inputs
- Long Term Accuracy
- Broad Environmental Tolerance
- Minimal Size, Weight, and Power
- Reliability

Figure 18

Figure 19 shows the performance typical of a good quality inertial guidance system. Note that the RMS position error increases at an ever accelerating rate and that longitude errors (being unbounded) are much greater than latitude errors. For a typical small high quality system today the unnormalized error would amount to several tens of nautical miles in ten days with no updating or adjustment. If one takes note of the fact, however, that land based nuclear weapons are at rest with respect to the earth's surface most of the time, one can do two things which markedly improve long-term accuracy.

First, one can so arrange the system that it senses relative rest and automatically ceases to accumulate position error during periods of no motion. In this way the time scale is lengthened in that it is made to apply to time in motion rather than elapsed time. The relationship is not directly linear, of course, if one does this alone. But one can take a second step. This is based on noting the ever accelerating rate of error buildup. Namely, one can attempt to reconfigure the system so that it uses periods of no relative motion for internal recalibration. If one does only this and computes the effect of one recalibration cycle per day, the result is to decrease the normalized RMS error by a factor of more than 5, as shown in Figure 20. This requires that one develop techniques for automatically changing gyroscope damping without imparting large oscillations, and a number of other unusual features.

These techniques have now been studied in some depth. Experimental checks using reconfigured, currently available equipment are now under way. To date, design studies and experimental data indicate that the tentative objectives shown in Figure 21 can be achieved. It should be pointed out that the current program does not encompass the creation of an experimental bread-board of such a system, but only analysis and the supporting experimental studies which can be accomplished with existing hardware.

NO CALIBRATION

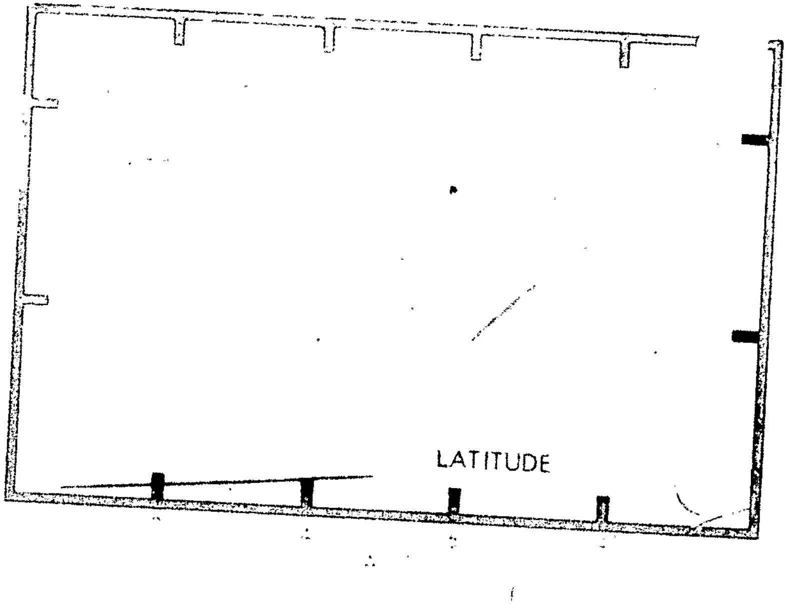

Figure 19

PARTIAL CALIBRATION (once/day)

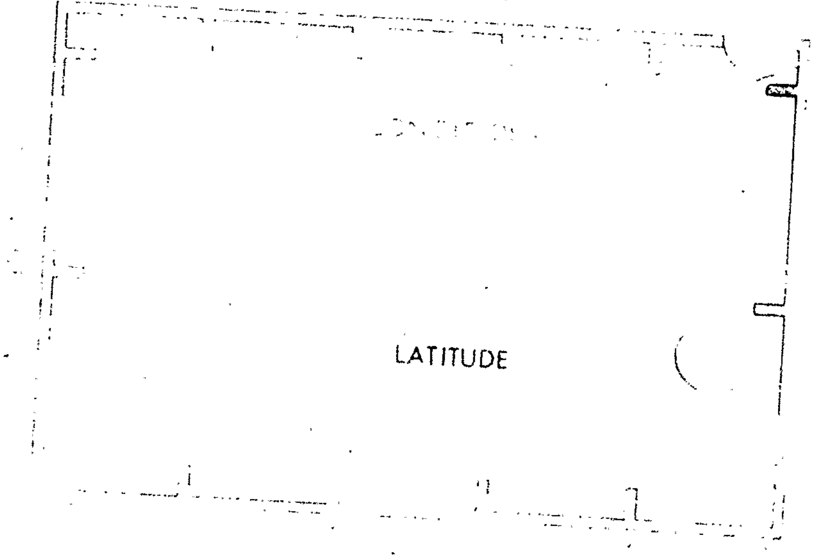

Figure 20

TENTATIVE GPL OBJECTIVES

Weight:	< 50 pounds
Volume:	< 0.6 cubic feet
Accuracy:	< 2 nm. in 24 hours/100 % d. c.
	< 10 nm. in 10 days/85% d. c.
	< 1 nm. in 100 days/15% d. c.
Temperature:	High + 160^0F, Low -65^0F
Vibration:	1 to 5g at various frequencies to 2000 Hz
Acceleration:	10g
Mechanical Shock:	43g, 17 msec
Power:	External, 200-400 watts
	Internal, 125 watts for 15 minutes

Figure 21

There are numerous other concepts for building more intelligent warheads which could also contribute to safety, effectiveness, and control and which are, to date, largely unexplored.

Requirements

Control systems can only be judged in terms of their ability to meet requirements. The key to framing requirements relevant to the prevention of unauthorized intentional nuclear detonations is the specification of the threat. Figure 22 lists the principal threat qualities requiring specification. Time refers to the period which begins with the first overt unauthorized action on the nuclear system. Previous periods spent in preparation, if any, are presumed to be reflected in enhanced equipment, knowledge, etc.

It is perhaps worth noting that in practice the apparently formidable job of specifying each of these qualities is really not too difficult. This results from the fact that a relatively coarse screening is an adequate criterion. Thus, for equipment, the following categories have frequently been used: available on site, surreptitiously-carried (1-10 pounds), one-man portable (10-100 pounds), truck portable (100-1000 pounds), and available at a national laboratory. For time differentiation, minutes, hours, and days will frequently be found adequate.

In developing requirements, other factors besides the threat must be considered (Figure 23). The outcome which is desired must be determined. For the posited case of a military overrun, does one wish the command destruct to destroy a portion of the nuclear assembly or the supporting electronics? Is this to be accomplished with minimal external violence, or is complete breakup and scattering of the weapon desirable? Is this to occur promptly or after some prescribed time?

THREAT QUALITIES

Time
Knowledge
Equipment
Goals
Probability

Figure 22

IMPORTANT ASPECTS

Threat Analysis
Desired Outcome
System Compatibility

Figure 23

For coded switches, is it desirable that an attempt to pick the lock by successive tries be met by the jamming of the lock, the destruction of the code, a switch to another more complex code; or does one simply want the switch to be so configured that picking will usually take a very long time?

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Perhaps there should be several options with code controlled selectability. For navigator systems, what types of map selection or formating would prove most useful? For excluded positions, should the response be simple inoperability (unresponsiveness), some level of internal disruption of the warhead, or destruction of the warhead as an entity?

Some of these outcomes will be influenced by the posited threat. Many will reflect the circumstances under which deployment is planned and the relationship of a given nuclear weapon to our total posture.

Finally, the hardware requirements governing control equipment must reflect the requirements of the system taken as a whole. Clearly the control subsystem requirements must be consistent with and achievable within the total system requirements.

One final comment seems appropriate in the requirements area. This relates to the initial assumption that in changing our tactical nuclear posture it will be necessary at each step to convincingly demonstrate that only the designated use can occur, that misuse is improbable. For this purpose it may well be necessary to evaluate situations other than military overrun (Figure 24).

TYPES OF OVERRUNS

Administrative
Military
Political

Figure 24

Thus one should consider what might be called administrative overrun—a situation in which orders issued to our own personnel are not executed in the field as intended in headquarters. Also of possible importance are situations arising out of political shifts within other nations or in their relationship to the United States—shifts which might result in political overruns.

Summary

Obviously the field of control technology is rich in possibilities, and there are many capabilities which could be developed. Not all of these are mutually compatible. The most beneficial level and the direction of research and development activities in this field are not clear. A broader awareness of the options available and a thoughtful comparison of these potential capabilities and future national requirements are required.

Question and Answer Period

ROWNTREE (NWC, China Lake): You made the basic distinction between authorized and unauthorized detonations. I realize that this may be a rather picayune point, but from a standpoint of requirement one might also wish to distinguish between authorized and unauthorized maintenance, opening up, investigation, etc. Do you understand my point?

GUSTAVSON: I understand your point. In fact, one frequently asks the question as to how we should relatively rate (a) giving, or losing, to somebody else the ability to create a nuclear detonation; (b) the loss of fissile material; or (c) the loss of design data. It is my personal feeling that the first of these is overwhelmingly important, although the others cannot be ignored, and we certainly will not willingly give away nuclear design information nor fissile material. It is true, however, that there are alternative routes to getting fissile material and design information other than stealing a US nuclear weapon or subverting its use.

ROWNTREE: Yes, I think the distinction between the alternate routes is a point which you made several times, that of timeliness.

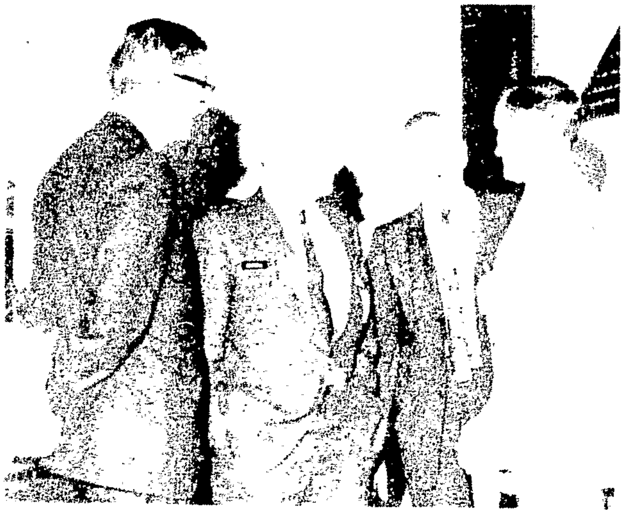
GUSTAVSON: Right.

FOSTER (SRI): Do you believe that control technology is available to allow, say, time-limited selective nuclear transfer to an ally of a certain type of weapon such as an ADM or an air defense weapon?

GUSTAVSON: As long as you don't make any more restrictions than that, the answer is definitely "yes." Now if you ask me to do it in too little weight or to make it operate for too long, then I may or may not be able to fulfill your detailed requirements. But there is an unused capability which can be brought into existence today.

COGGAN (North Am. Rockwell): Because of the nature of our company, I'm intrigued by your position/location interest. Could you elaborate a little? Would it be necessary to have such position/location information available at the site of the nuclear device, or do you want it available at some remote point?

GUSTAVSON: Our tendency has been to look upon this in terms of whether or not the system could be misused. When we separate site location from the actual nuclear warhead, we have a very difficult question to answer, and that is, "Is it possible somehow to interfere with the system which locates where we are and the nuclear warhead?" Therefore, we've been attempting to shorten that link to the point where they were both in the same container, and thereby get around the question of how do we protect data links running from some remote site.



[redacted]

John E. Dougherty
Los Alamos Scientific Laboratory

NUCLEAR PROJECTILES FOR ARTILLERY

Introduction

This morning I will present various aspects of nuclear systems designed for tube artillery. The projectiles now stockpiled will be briefly reviewed; I will remind you of some of the limitations or undesirable features of these projectiles; then we will look at designs which are feasible using current nuclear weapon technology; finally, I will point out some of the directions that future development might take.

I think it is worth noting right away that the constraints on the design of nuclear warheads for tube artillery (see Figure 1) put unusual demands upon the weapon developers—almost every characteristic required for gun launched systems is exactly what you shouldn't have in an efficient weapon. The first problem is diameter. DELETED Weight is another area, as is yield, in which the demands of the delivery system and of the nuclear designs would dictate opposing courses of action. The structure of a projectile which is subjected to 15,000 g's represents a considerable challenge, especially when there are things to be held together or apart by weightless supports.

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Projectiles Now in Stockpile

Let's look at our current stockpiled designs, the 8 inch and 155 mm projectiles (see Figure 2). The 8 inch has been in stockpile since January 1957, and the 155 mm since October 1963; almost 13 years and 6 years, respectively.

[redacted]

Figure 1

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CHARACTERISTICS OF 8 INCH PROJECTILES

	M-422	STANDARD M-106
DIAMETER	8 INCH	8 INCH
LENGTH	36.75 INCH	35.1 INCH
WEIGHT	244 lb	200 lb
SETBACK ACCELERATION	8,000 g	11,000 g

Figure 4

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UNDESIRABLE PROPERTIES OF M-422

1. NOT A BALLISTIC MATCH TO M-106

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3. MUST ASSEMBLE IN FIELD
4. EXPENSIVE IN ACTIVE MATERIAL
5. MECHANICAL TIME FUZE

Figure 5

Now, what things about this device would one try to change for a better design (see Figure 5)?

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One property, not realized until recently, is that it is pretty hard to quietly disable one of these.

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The characteristics of the Mk 48 are shown in Figure 7. Again, there are properties of the Mk 48 which one wishes it did not have. Some are shown in Figure 8.

CHARACTERISTICS OF 155 mm PROJECTILES

	MK - 48	STANDARD M-107
DIAMETER	6.1 INCH	6.1 INCH
LENGTH	34 INCH	27.5 INCH
WEIGHT	120 lb	95 lb
SETBACK ACCELERATION	8,800 g	9,900 g

Figure 7

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UNDESIRABLE PROPERTIES OF MK-48

1. NOT A BALLISTIC MATCH

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Figure 8

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New Developments

Now let's discuss what the AEC laboratories have been doing that is pertinent to nuclear artillery.

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I would like to digress just long enough to give you an appreciation of these advances. I'm sure that the effect of these developments will be increasingly noticeable in future weapon programs.

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Figure 9

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Considerable work has been done in a second area that is important to nuclear projectiles—structural design. Ways to make structures lighter, yet sufficiently strong to do the job, have been studied. New materials are being used, and new ways to use old materials are undergoing investigation.

We must also include advances made in the understanding of how the design of two-dimensional nuclear assemblies can be optimized.

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Experimental checks are of course made, but to save having to make an impossibly large number of experimental observations, one relies heavily on calculations. The better they are, the more likely one is to arrive at good pit and high explosive designs.

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Figure 10

A second approach to the 155 mm design was begun in 1965.

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The first two tests of this design were only partially successful; the third, in November 1968, was successful.

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Figure 11

New Projectile Designs

I want to describe now the applications of the new systems to current nuclear projectile requirements.

Figure 12 summarizes some of the principal requirements which have been stated as the basis for Phase II studies held in December 1968 and February 1969.

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Let's look at the 8 inch first. Quite a few ways were proposed for doing the 8 inch job, but let me limit my discussion to a few of the more interesting ones.

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The basic nuclear assembly shown in Figure 13a can be built into either the standard high explosive shell M106, (Figure 13b), or it can fit into the longer shell profile of the proposed rocket boosted projectile XM650 (Figure 13c). There is not much room left for rocket propellant in the XM650.

NEW PROJECTILE REQUIREMENTS

DIAMETER	8 INCH	155 mm	175 mm
WEIGHT	200 lb	96 lb	147 lb
SETBACK ACCELERATION	11,100 g	14,100 g	15,000 g
BALLISTIC MATCH REQUIRED	M-106, XM-650	XM-549, M-107	M-437

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Figure 12

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Figure 13a

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Figure 13b

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Figure 13c

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Figure 14

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It does give you an appreciation for the kind of technology that can be called upon for current and future systems.

There are other possibilities in this size. Perhaps one more special case is of interest. If there is a strong interest in using all the rocket fuel that you can get in an 8 inch RAP, then the shortest nuclear system would be desirable.

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Figure 15

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Figure 16

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Remember that the requirements (Figure 12) ask for a ballistic match to either the XM549 or the M107, the choice to be made later. The XM549, however, seems to be favored. There may be yet a new shape, but until we know what it is, we use these two.

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Figure 17

This projectile also meets the principal requirements defined by the Phase II information.

There is no activity at present on warheads for the 175 mm.

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Figure 19 summarizes, perhaps in an oversimplified way, the possibilities for warheads in the projectile sizes just discussed.

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Figure 18

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Figure 19

The Future

The question of guidance always comes up when one tries to see what kind of devices may be of interest in the future. It probably boils down to who is guiding whom. At any rate, extrapolating from the past, I have collected some thoughts on what might happen in programs to develop projectiles for small diameter high-g delivery systems.

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Figure 20

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Advances in this area would allow savings of active material, or the achievement of higher yields for a given amount of nuclear material.

Development and applications for very low yield devices have not received much attention in the past. There are ideas for making devices, not necessarily projectiles, with yields of a few tons that would be relatively cheap, small, and light (see Figure 22). We don't know about applications, but the possibilities are interesting.

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Question and Answer Period

COWAN (3rd Armored Division): Has Formaggio been fired?

DOUGHERTY: No sir.

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COWAN: If this thing works at all, it would be an ideal candidate for an atomic demolition munition, wouldn't it?

DOUGHERTY: Well, it's not suppressed radiation, for example. It all depends on how hard people beat on certain requirements in that area. I think it's interesting.

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DOUGHERTY: Yes, I said, "Draw the simplest gadget you can think of, no complicated electronics and things like that. Just let me pull the plug out and then set a timer and it'll go." I would think if you could keep things simple it might have a certain attraction.

Cecil I. Hudson, Jr.
University of California
Lawrence Radiation Laboratory

CLEAN NUCLEAR EXPLOSIVE RESEARCH APPLICABLE TO TACTICAL NUCLEAR WEAPONS ([redacted])

Introduction

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During the past eight years, we have succeeded in developing nuclear devices which can tailor the output in a number of different ways. Two such devices are described in this paper: a clean, suppressed neutron output device, and a clean, enhanced neutron output device. Both have potential applications as tactical nuclear weapons.

Figure 1 lists some of the features of these two types of weapons. The clean, suppressed neutron output weapon is designed to kill primarily by blast, while producing a minimum amount of fallout.

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The user of a tactical nuclear weapon is generally interested in producing a given effect (such as achieving a desired kill probability on a target or over a given area) while reducing collateral effects (especially fallout, which is subject to variation depending on the wind). A number of methods may be used to reduce local fallout, such as airbursts or burial. A combination of very accurate delivery and very low yield may also be used to reduce local fallout. These methods are summarized in Figure 2. Figure 3 shows the yield and CEP combination necessary to kill overpressure targets of different hardness. Inherent weapon cleanliness or weapons with special effects may also be used to reduce fallout. This is particularly true in cases where a surface burst is desired or required, where very accurate delivery cannot be achieved, or where a very large yield is needed to produce the desired effect.

CLEAN, SUPPRESSED NEUTRON OUTPUT WEAPONS

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Low neutron output per unit yield.

Can be used with a modular warhead concept.

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CLEAN, ENHANCED NEUTRON OUTPUT WEAPONS

High neutron output per unit yield.

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Figure 1

Fallout can be reduced by using:

1. Airbursts
2. Underground bursts
3. Very low yield combined with accurate delivery
4. Inherently clean weapons
5. Special effects weapons

Figure 2

It might be worth digressing to mention that the dialog which took place between the AEC and DOD on the utility of clean nuclear weapons led to an improved understanding of the utility of the hitting missile and of burial of demolition munitions. Both of these applications are now generally well understood. However, our currently programmed tactical nuclear force has severe limitations due to radioactive fallout when considered in conjunction with current targeting plans. In several cases, if actual US target arrays (from previous years) are considered, the fallout due to using ADM's or laydown bombs is sufficient to cover a large portion of the area with a dangerous dose level.

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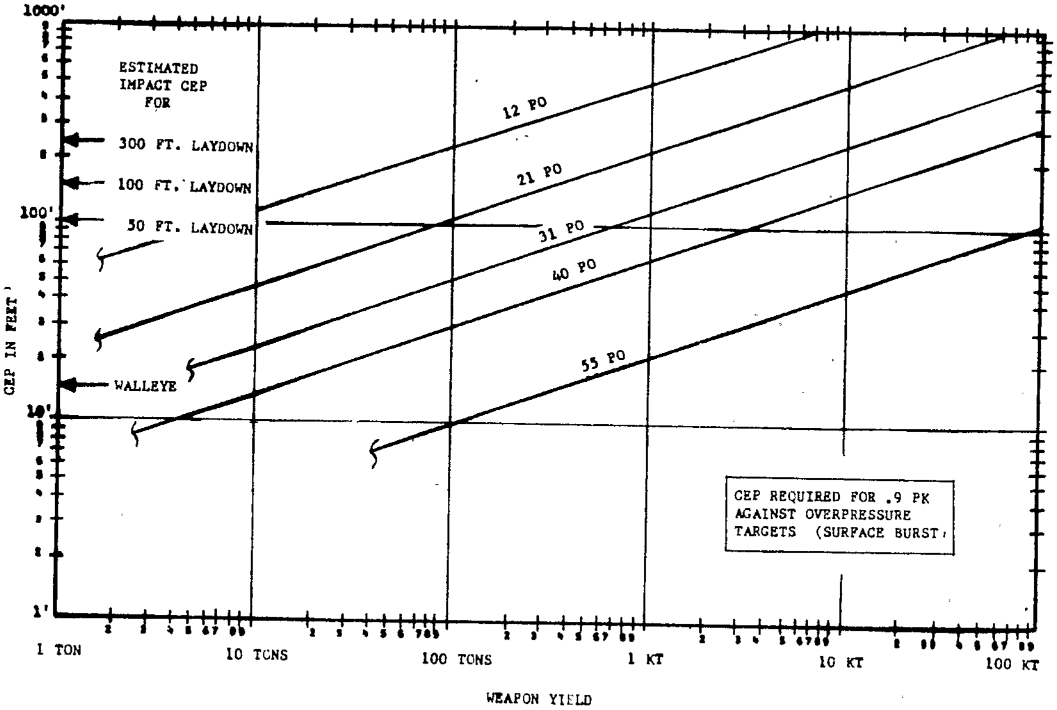

Figure 3

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Even if all the fission could be eliminated, there would still be a substantial amount of radioactivity due to neutron activation. Figure 5 shows the equivalent fission yield as a function of total yield for different values of neutron output per kt. The surface burst values are smaller because most of the neutrons escape into the atmosphere without being absorbed in the soil. Different soils result in different degrees of neutron activation. Figure 6 gives the fission equivalent for neutron activation of five of the soils listed in TM 23-200. Note that there is an enormous variation among the various soils.

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Note that the downwind distance is much less variable with the clean weapon. This is shown more clearly in Figure 8, which shows the downwind distance as a function of wind speed.

SOURCES OF RADIOACTIVITY

- Fission products
- Induced activity
  - Internal, in weapon materials
  - External, in soil, water, or other materials

NEUTRON INDUCED SOIL RADIOACTIVITY

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A typical soil (Nevada alluvium, Type 2), when irradiated by a mole of neutrons, has the same integrated gamma dose between .5 and 4.5 hours, or the fission product from 250 tons of fission.

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Figure 4

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Figure 7

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Figure 11 compares the radiation kill effectiveness of several different weapons. Since there is some disagreement on the radiation dose required for kill, both 1000 rad and 10,000 rad contours are shown. One advantage with enhanced neutron output devices is that the weapon has more of a "cookie cutter" effect than a standard fission weapon of the same yield. The figures along the bottom of Figure 11 give a measure of the "crust," or ratio of safe separation radius to kill radius. Enhanced neutron output weapons may also have radiation kill ranges which exceed the blast kill range, allowing some degree of separation of effects.

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Figure 8

History of Development of Clean Weapons

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Figure 9

Several types of clean devices were successfully tested.

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Work in this field was very active from 1962 to 1965. Figure 12 lists the number of tests in these programs.

It is interesting to note that testing of suppressed neutron output devices stopped in 1967, though some additional work in this area has continued under the Plowshare program. This reflects a program that was carried to a certain degree of design maturity and then put on the shelf, because there was no application available at the time. Enhanced neutron output devices would be in a similar state if they were not being developed as antimissile defensive warheads. The AEC laboratories can carry new concepts in advanced weapons only so far. If there is no evidence of DOD interest over an extended period of time, higher priority programs invariably displace the unwanted concepts.

What have we accomplished to date?

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We have also demonstrated the feasibility of enhanced neutron output weapons. One of these was under development as the W63 warhead for the Lance missile until it was cancelled.

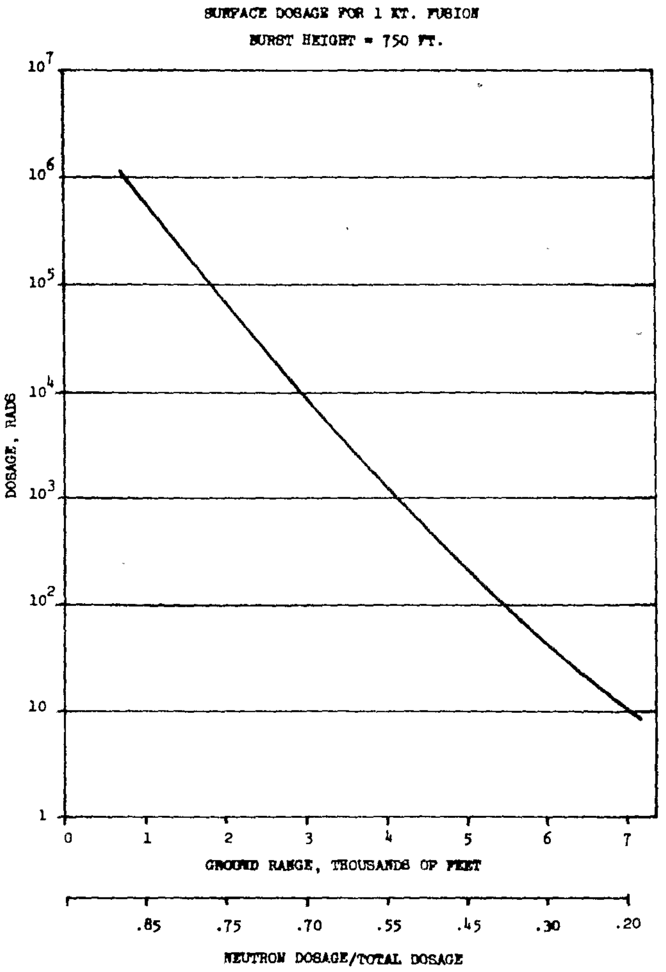

Figure 10

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However, it is very large and heavy compared to a typical nuclear weapon. Figure 13 compares a clean, suppressed radiation weapon which might be used as a nuclear demolition munition and a clean Plowshare-like explosive which might be used for military construction purposes, such as constructing harbors or dams, or other large scale earth moving projects.

[redacted]

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Figure 11

Characteristics of Clean, Suppressed Neutron Output Weapons

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Figures 15 and 16 give the size and weight as a function of yield of a family of clean, suppressed neutron output weapons. The current Plowshare explosives are shown for comparison. An estimate is also made of the size and weight of a possible future clean, suppressed neutron output device with a reduced fission yield.

Figure 17 compares the fallout from two clean, suppressed neutron output devices with the fallout from an all fission device. This demonstrates some of the tradeoffs possible by trading size or weight for cleanliness.

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As I mentioned earlier, it is possible to reduce radioactive fallout by burial of a munition. However, experience in the Plowshare program has shown that the burial must be done with great care, that the media must be well characterized, and that the stemming must be done in a manner to match the hydrodynamic characteristics of the medium in which the explosion takes place. If not, only a small reduction in fallout is possible. Figure 18 shows the experimental results of the fractional radioactivity released as a function of scaled depth of burst from all of the cratering shots which we have conducted. The two extremes indicate what may be expected if great care can be taken in emplacing the explosive or what might happen if the medium is not well understood or if the explosive is not properly emplaced and stemmed. The message from this curve is that you can't count on getting the reduction in radioactivity shown by the lower curve unless a great deal of time is available to study the emplacement geology and to carefully calculate the stemming and containment. Figure 19 gives the fallout area as a function of yield for a buried fission device. Another case where burial may be difficult is in hard rock. Figure 20 shows crater dimension in hard rock as a function of yield. It is possible to obtain the same crater diameter with one tenth the yield if the explosive can be buried at near the optimum burial depth. For craters of 300 feet, a 1 kt explosive must be buried deeper than 100 feet.

Characteristics of Clean, Enhanced Neutron Output Weapons

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Figure 13

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Figure 14

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Figure 15

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Figure 16

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Figure 17

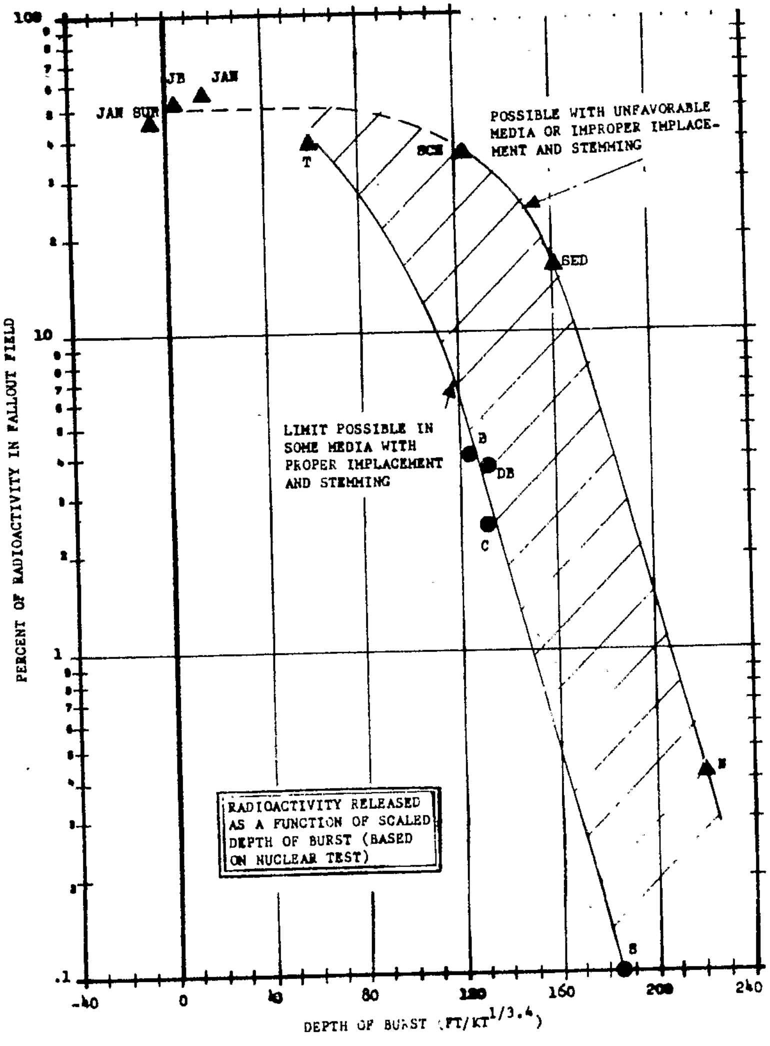

Figure 18

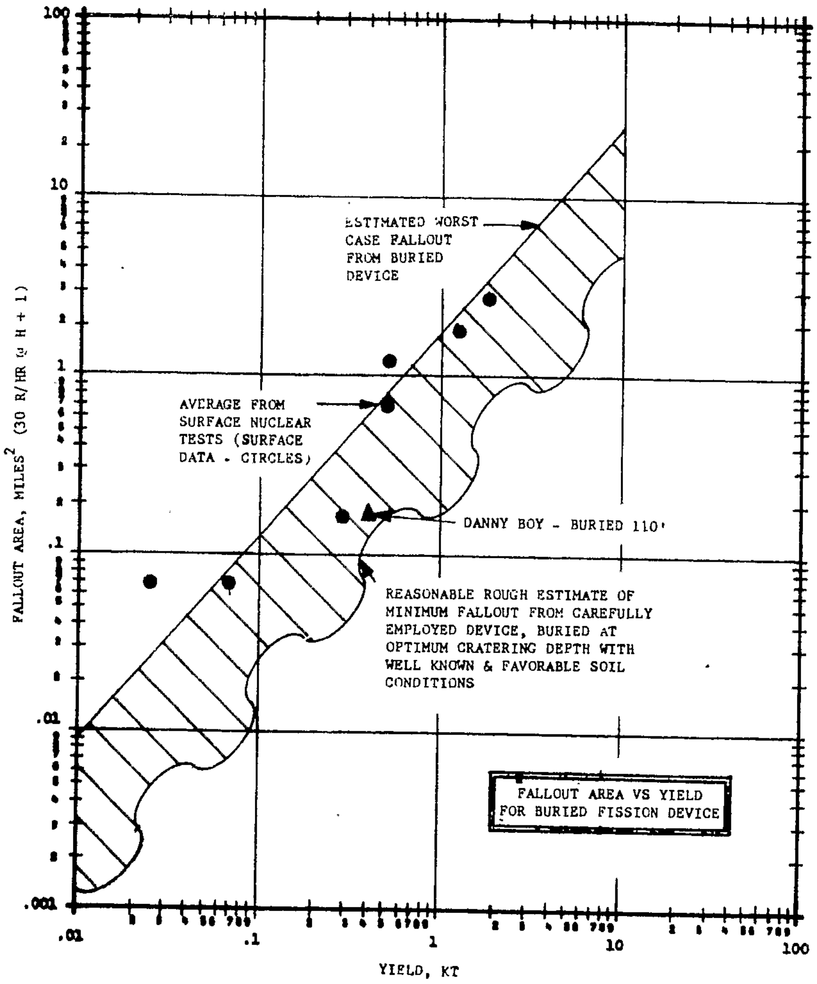

Figure 19

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Possible Applications

Clean, suppressed neutron output weapons may be used as demolition munitions, laydown bombs, tactical missile warheads, or ASW warheads. Figure 23 shows the total gamma dose rate as a function of time for a clean, suppressed neutron output weapon surface burst in a typical soil, and Figure 24 shows the gamma dose rate as a function of time for an underwater burst of the same weapon. In the latter case, the dose rate is dominated by fission, so that for ASW application, low fission is more important than a suppressed neutron output. Clean, enhanced neutron output weapons may be used as bombs or tactical missile warheads, using a design similar to the W63, which was the initial warhead design chosen for the Lance missile.

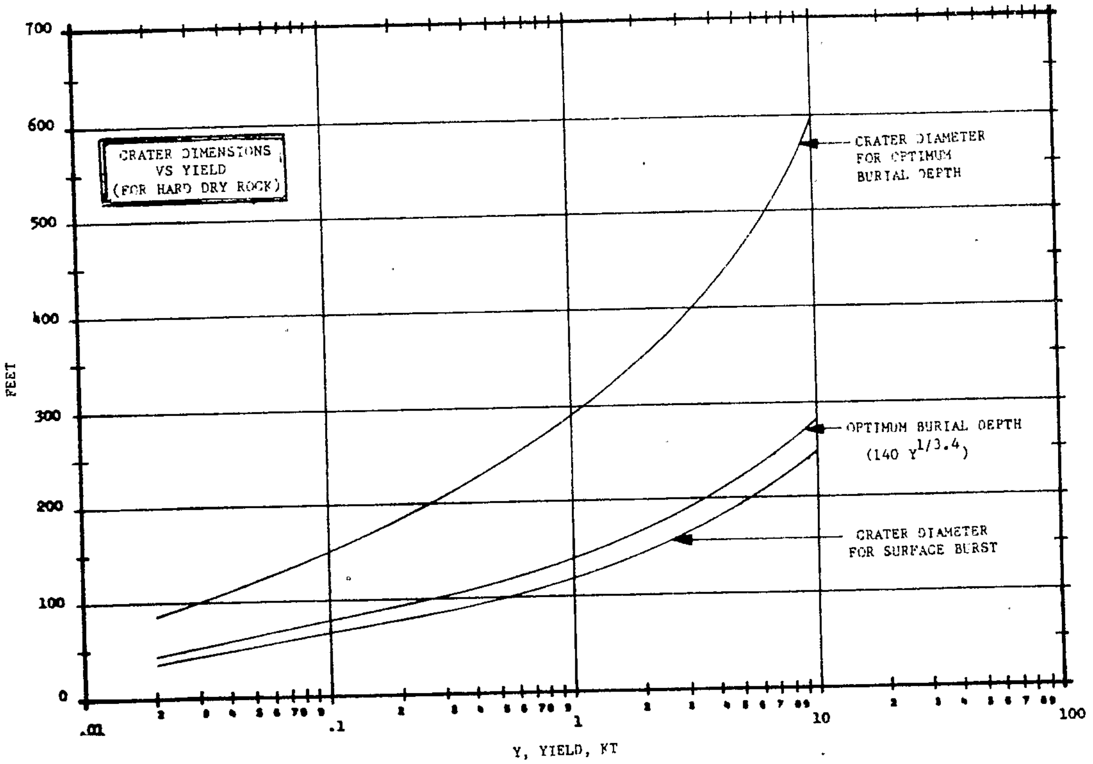

Figure 20

In cases where a dual capability is required, the nuclear warhead weight and size are not of major importance. (Two obvious exemptions are demolition munitions and artillery shells.) This is because the conventional warhead may weigh several hundred to a thousand pounds. Sufficient size and weight are available to enable clean weapons to be used in almost all tactical missiles, and in many tactical bombs. This would allow a degree of flexibility that we do not now have, at the same time reducing collateral effects (especially fallout).

A tactical nuclear force containing such weapons, combined with hitting missiles with very low yield weapons, would provide us with a credible, flexible tactical nuclear force. There is a school of thought (with some apparent influence in recent years) which holds that the last thing we want is a credible tactical nuclear force—that an incredible force reduces the chance of our initiating a limited nuclear war and thus

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Figure 21

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Figure 22

helps maintain the nuclear firebreak. Perhaps this is so. But if we have an incredible tactical nuclear force—one which we do not believe in and cannot use, either on technical grounds or because of lack of proper command and control—then if our enemies choose to start a limited nuclear war, we may find ourselves hamstrung, or unable to respond other than with a massive degree of escalation. I would like to see a credible tactical nuclear force. It seems to me that such a force would have increased value as a deterrent because it is usable, flexible, and capable of a controlled response.

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Figure 23

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Question and Answer Period

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HUDSON: I don't think I have it with me.

MORSE (SRI): I think you said, or implied, that after twelve years of laboratory effort there is still no military requirement for either enhanced or suppressed radiation. Is that correct?

HUDSON: There is a stated desire in the current ADM Phase II for a suppressed radiation module. With the exception of the use as an antimissile warhead, there are no other applications for an enhanced neutron weapon. It would be quite useful as an antipersonnel weapon but there are no current requirements for it.

MORSE: I don't suppose you would want to guess why?

HUDSON: I have some opinions, but I'm not sure they are accurate. I think one problem is that they were new a number of years back; in addition, people don't quite have the intuitive feel for radiation as a kill mechanism as they do for blast; they feel that it is probably much better to "bang" somebody than "zap" them.

LAWLER (CDC): With respect to the ADM problem, if you tailor your device to the size of obstacle needed, and you judge your needs per yield against what you can get, and it turns out to be less than what the SR driver needs, there would be little utility to go to the SR device except for those requiring large obstacles.

HUDSON: If the required yield is less than the fission yield you have, there is no point in using a suppressed radiation device.

RUMNEY (SRI):

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HUDSON: It is possible. I think you could get some idea from the curve showing the gamma dose rate as a function of time. To deliberately enhance the gamma output during a given time period by perhaps an order of magnitude over that of a weapon with the same fission yield, during that same time period, we looked at this just in a cursory fashion. We haven't actually taken a given design and seen if the materials with the desired neutronic properties also are things from which you can build devices. We haven't tried to weaponize anything of that sort. It's actually pretty hard to beat fission. You can beat it with gammas but not with betas.

RUMNEY: **DELETED**

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When you consider using this type of weapon in Europe it may find greater long range acceptability. This is the reason I asked the question over the fission.

(Ed. note: The following comment was subsequently added by Mr. Rumney for inclusion in the Proceedings.)

Fallout is often a dominant consideration in nuclear weapons policy and politics. Consequently, its elimination or reduction is often assumed to be automatically desirable wherever possible, and the use or enhancement of fallout is not a subject for current rational political debate.

Politics, however, can vary rapidly in response to pressures and perceptions. Crises and pain tend to accelerate these responses, and it is therefore prudent to base predictions of future policy (and subordinate long-range technological developments) on an expectation that reality will be perceived, rather than on current prevalent distortions and misconceptions.

Thus, today, words like "fallout" and "radiation" cause automatic and all-inclusive negative political reactions, and mention of a "salted" weapon can be expected to cause downright hysteria. In the future, however, the ability to discriminate where there are real and substantial differences must be prepared for. In the case of fallout, it is the long-term danger of "poisoning" the earth which is the principal cause of fear. The real basis of this fear is the presence of isotopes which are significant internal radiation hazards—those with both a long biological half-life and significant radiation emission, particularly those with genetic implications. Cesium, strontium, and iodine are usually dominant internal hazards.

Military fallout effectiveness as a barrier is not dependent on the internal radiation dose, and can be achieved through isotopes which are comparatively insignificant from an internal viewpoint, provided fission energy release is minimized. Thus, militarily effective fallout from salted fusion weapons could be made to avoid the most significant political consequences of fission weapon fallout. Radioactive half-lives can be either long or short, as long as the internal biological half-life is short.

This possibility may not cause immediate enthusiasm, since the creation of radiation barriers may not achieve its greatest significance in the context of confrontations between major powers. However, in situations where stabilizing influences are required and major troop deployments are undesirable, particularly in conflicts between client nations of the third world, such options can be expected to become more desirable. In many cases, proliferation may have introduced nuclear weapons into such crises, regardless of US restraints in that area. The ability to separate opponents, impede maneuver, destroy momentum, and provide selective denial of critical areas may be the most stabilizing influence available as the permissible level of violence rises from below the umbrella of mutual strategic deterrence.

As perception grows that blocking, halting, denying capabilities can be the most stabilizing of influences once conflict is joined, it will be important that we understand that more politically acceptable fallout options can be made available. The question was raised in order to point out this technological option.

5

Colonel Sid C. Bruce, USAF (Ret.)
AECOP

WARHEAD COSTING

AECOP is a multicontractor group located at Oak Ridge, Tennessee, which does analysis and combined planning studies for the Division of Military Application and Division of Production, AEC Headquarters.

One of the tasks that we have been involved in is the development of methods for proper economic evaluation of warhead alternatives. This can be simply stated as "warhead costing," and that is what I will be talking about. Colonel Shaw will follow me and pick up the subject of availability of special nuclear materials.

Now, with regard to "warhead costing," please note that I am not using the term "cost of warheads" as shown on the agenda. What I am not going to talk about is the cost of specific warheads or design proposals. Preparing cost estimates for various warhead alternatives is the responsibility of Weapons Development Division at Albuquerque Operations Office, not of AECOP. We in AECOP only assist ALO by developing basic concepts for meaningful evaluation of warhead alternatives. I will, therefore, limit my discussion to the basic principles currently in use for warhead costing, with special emphasis on costing of special nuclear materials (see Figure 1).

In this portion of our briefing I will cover the following areas: First, I want to review with you the rationale that was used in developing the per gram dollar costs for oralloy, plutonium, and tritium which are currently in use within the Atomic Energy Commission.

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WARHEAD COSTING

- Proper Unit Costs SNM:
  - Oralloy
  - Plutonium
  - Tritium
- Application - Net Warhead Costs.
- Results - Comparison.

Figure 1

Second, I want to show you how we apply these unit values in deriving an overall net warhead cost which is used in economic comparison of alternative warhead proposals.

Third, I would like to show you what happens when you use this method of costing by comparing it to other methods that have been used in the past.

However, before talking about unit costs for special nuclear materials, I feel that we should put this matter of "warhead costing" into proper perspective—to avoid the misconception that net cost is our only "thing" at AECOP. Let me see if I can make this point with Figure 2.

Shown here are some of the key elements in the decision making process. To be sure, it is not a complete list; the point is, however, that costs are only one of the many elements in the decision making process, and must be considered in that context. Further, you will note that the subject of costing can involve many subelements: one, for instance, is budget costs; another is net warhead investment; still another is total cost—how the cost of the various warhead alternatives impacts on the total cost of the weapon system. Now I'm only going to be talking about one of these, namely net warhead investment.

Net warhead investment, for purposes of this discussion, includes all direct costs which can reasonably be associated with a decision to build the nuclear warhead or bomb. It includes not only the required additional budget dollars but also all funds which may be already allocated, but which have to be diverted from some other project or objective. An example of diverted funds might be those for research and development, which is normally funded in AEC on a level-of-effort basis. While additional funds may not be required to develop and test a new Phase III warhead, projects will have to be reoriented and funds will probably have to be diverted in order to accept this additional requirement.

ELEMENTS - DECISION MAKING PROCESS

- Benefits:
  - Kill Effectiveness
  - Availability - Ease of Delivery
  - Ease of Maintenance, etc.
- Costs:
  - Budget Consequence
  - Net Warhead Investment
  - Total Costs, etc.
- Political Considerations
- Etc.

Figure 2

With these thoughts in mind, let us turn to unit costs for special nuclear materials, the first of which is oralloy. By definition, oralloy is 93.15% U235 enriched uranium. Other degrees of enriched uranium will, of course, have different unit costs. Such unit costs, however, can easily be calculated from this basic oralloy cost by considering the relative amounts of contained U235.

As most of you know, and as Colonel Shaw will reaffirm in a moment, we do have sufficient oralloy reserve on hand to meet all projected demands with the possible exception of the JCS recommended stockpile as presently configured in Annex C to JSOP. Because we do have a rather large reserve of oralloy, it is no longer being produced for military weapons. Let us look, however, to the total AEC picture, not just to the weapons customer.

Figure 3 serves to make the point that the large demand for enriched uranium in the 70's is in the civilian power reactor market. As a matter of fact, all studies show that by about 1980, just 10 years from now, the demand for civilian power fuel will exceed AEC capacity to produce. New gaseous diffusion plants will have to be built by that time unless some other source of supply is found. Clearly, an alternative to building new plants is to use surplus oralloy from our weapon reserve. One kilogram of oralloy at its high enrichment can be blended with natural uranium to make approximately 36 kilograms of low enriched fuel for power reactors. Thus, it can be seen that oralloy can be used either in weapons or in an alternative market to delay the time of building new gaseous diffusion plants.

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FORECAST - ENRICHED U235 DEMAND
By Customer
1970 through 1980

	Million $'s
Civilian Power Fuel	10,000
Government	740

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	740

Figure 3

The question then becomes, "How much is oralloy worth to this alternative market?" The answer is that at the time of new plant construction, estimated to be about 1980, oralloy will be worth about $ 8-1/2 per gram. That is, for every gram of oralloy used in 1980 to delay the building of new plants, there will be a net saving to the government of $ 8-1/2.

To be consistent, any oralloy used in 1980 for a military weapon, in place of being used to produce reactor fuel, should be assessed a charge of $ 8-1/2 per gram. Shown in Figure 4 is this $ 8-1/2 value corresponding to the assumed new plant date of 1980. Corresponding descending values are shown prior to 1980. Now, the reason that the values prior to 1980 are less than $ 8-1/2 is that the actual effect of deferring new plant construction will not be realized until 1980. Something that can be sold in 1980 for $ 8-1/2 could be sold to a private investor today for about $ 4.00, if that investor is willing to make approximately 7-1/2% on his money. If he wants to

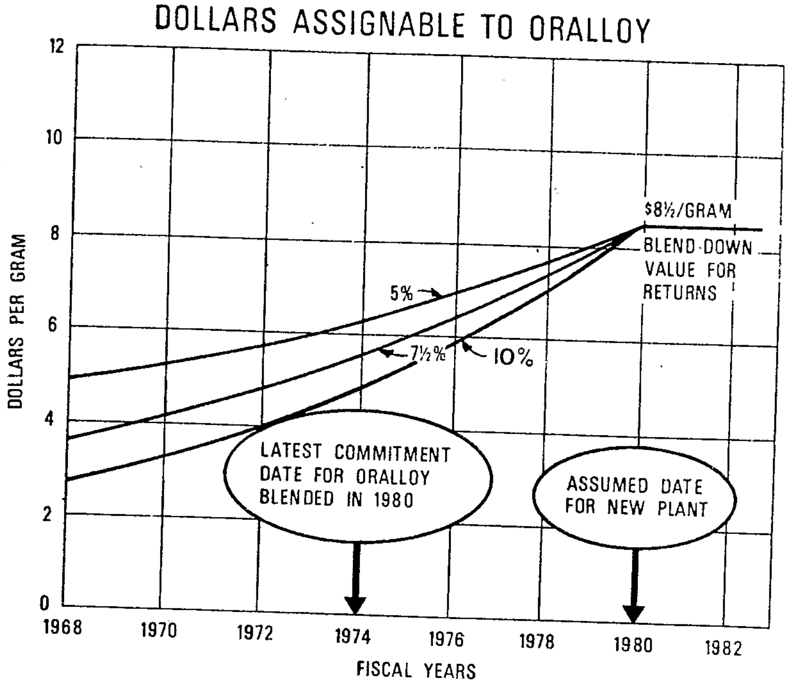

Figure 4

make 10%, he would be willing to pay only about $ 3-1/3 per gram. As you can see, we have plotted the discount curves for 5%, 7-1/2%, and 10% from the $ 8-1/2 value at the assumed new plant date of 1980. Depending upon the desired discount rate for a particular analysis, the appropriate cost of oralloy can be determined for any intervening year between now and 1980. Phase II cost studies are currently being made by AEC using a 7-1/2% discount, with sensitivity analyses being made at 5% and 10%.

I might say in passing that in order to defer all costs for new plant construction scheduled to be needed in 1980, it is necessary to make commitments to release material ahead of that time. Shown here is a 6-year commitment lead time—the amount of time required to contract and build new gaseous diffusion plants and procure power.

Having established appropriate costs for oralloy, let us now turn to plutonium and tritium. By way of introduction, let me state two facts: One, plutonium and tritium, unlike oralloy, are not in surplus but are currently in production to meet future requirements for military weapons; and, two, approximately 25% of the cost of producing plutonium and tritium comes from fuel burnup. The fuel being burned up in production reactors is U235 at some degree of enrichment. Savannah River's reactors, as a matter of fact, currently are using mostly oralloy. Since the cost of uranium is time dependent, so must the cost of producing plutonium and tritium be time dependent. This is shown in Figure 5. You will note here that again we have plotted on the vertical scale marginal costs in $ /gram for plutonium equivalent. Again, on the horizontal, we have plotted time in fiscal years.

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This is the marginal cost of producing plutonium in 1980 with oralloy valued at $ 8-1/2. Prior to 1980, the production costs will be less because the oralloy fuel costs are less, as was indicated in the previous figure.

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As I previously mentioned, Phase II cost studies are currently being made using a 7-1/2% discount rate rather than a time average value. Sensitivity analyses are being made for both 5% and 10% discount rates.

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You will recall that in this discussion of warhead costing, we wanted to cover not only the appropriate costs for special nuclear materials, but also the application of these values in the determination of the net warhead costs. To apply these unit dollar costs for oralloy, plutonium, and tritium in conjunction with the other costs such as R&D, test, fabrication and assembly, a few basic principles must be established (see Figure 6).

BASES FOR NET WARHEAD COSTS

- Consider "Total" Market
- SNM Not "Consumed"
- "Time-Value" of Money

Figure 6

With regard to the first principle, we all know that with the exception of tritium decay, special nuclear materials can be, and have been, used over and over again. For example, it is quite possible that material reclaimed from the Mk 5 bomb was used in the Mk 25 air-to-air rocket and is now reentering the stockpile in the Mk 61 bomb. In the absence of an all-out nuclear war, these materials are tied up, not consumed. The economic dislocations that will result from an all-out nuclear war will render such analyses as net warhead costing meaningless. Therefore, since these materials do have a residual value, the decision of whether to build or not to build a particular warhead must take into consideration the fact that these materials will be recovered at the end of their useful stockpile life. This is accomplished by including credits in the economic analysis for all materials returned at retirement. For illustrative purposes it will be assumed that the stockpile life for a warhead entering the inventory at the end of 1973 is ten years. Materials will be available for reuse in about 1984 if an additional year's delay is assumed for pipeline.

With these principles in mind, let's look at a typical cash flow profile for a nuclear warhead (see Figure 7). Let me first point out the fact that all cash flows are time oriented. All expenditures are shown below the horizontal line and credits are shown above the line at the time they are expected to occur. Cash flows are expressed in millions of dollars. Also please note that the initial operational capability date is identified by an arrow above the line at the beginning of FY 1974.

A three-year delivery program is assumed with fabrication and assembly expenditures for the total production occurring in 1973, 1974, and 1975. Other expenditures include development, test, maintenance, and plutonium and tritium.

CASH FLOW PROFILE OF A WARHEAD ALTERNATIVE

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Figure 7

Initial retirement as shown by the arrow below the line is assumed to start in FY 1984. A two-year retirement period is assumed in FY 1984 and 1985 with credits for plutonium and tritium occurring one year later in FY 1985 and 1986.

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Next, we want to convert these annual cash flows to a common base so that the overall warhead cost of this alternative can be compared to other alternatives. The common base that we use is the present value of all cash flows; that is, expenditures and credits are expressed in terms of present year dollars by discounting annual cash flows to the present year (see Figure 8).

All net annual expenditure undiscounted is represented by the total length of the bar below the horizontal line. All net credits undiscounted are shown by the total length of the bar above the line. Also shown are the annual cash flows when discounted at 7-1/2% to the present value. Note in particular that the credits which are occurring 15 and 16 years from the decision year have been reduced by more than 50%. The reason, of course, that these credits must be reduced is that if the amount of money shown were available today, it could be invested at 7-1/2% and return an amount equal to the total length of the bar. You will note that expenditures which occur only a few years from now have been reduced only slightly.

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PRESENT VALUE (COST) PROFILE

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Figure 8

I would like to make one additional point. This particular cost profile is related to a decision to either build or not to build a new warhead. Since this system has not yet been developed, R&D, test, construction, and equipment expenditures must all be included. If the decision were related to a system already in production, and the question was "What would an additional quantity of warheads cost?"--the answer would be, "Considerably less." The reason is that many of the early-year expenditures would have already been made, e. g., R&D, test, construction, and equipment. The point is that an additional build will cost less per weapon that the first increment. This point will be brought out more clearly.

Figure 9 shows the difference between the net present costs of a warhead alternative and the net cost of the same alternative obtained by one-time charging.

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This is obtained by adding all expenditures, taking no credits for materials returned, and ignoring the time value of money.

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As can be seen, most of this difference comes from the cost associated with nuclear materials.

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Finally, I would like to invite your attention to the fact that the unit net warhead costs can be significantly different—depending upon when the question is asked. To make this point I would like to show two examples of costing on the Spartan warhead. Both of these unit costs we consider to be correct.

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Figure 9

The first example (Figure 10) involves the question, "What is the estimated unit cost of a Spartan warhead before development began when the Sentinel decision was announced in 1967?" Note that this decision is concerned with expenditures for development, test (including the cost of the supplemental test site), capital equipment, etc.

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Now let's look at the same system but at a later period of time (Figure 11). In this example the question is, "What is the estimated unit cost of additional Spartan warheads in 1970?" You will note that this decision is concerned only with expenditures of fabrication, assembly, maintenance, and special nuclear materials—research, development, test, construction, and equipment expenditures by this time are essentially completed.

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WHAT IS THE QUESTION?

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Figure 10

WHAT IS THE QUESTION?

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Figure 11

In conclusion, I would like to summarize four main points.

1. The appropriate dollars to be assigned to special nuclear materials are all time dependent.

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2. In the application of these dollar values in net warhead costing for economic comparison between alternatives, it is appropriate to consider credits for material returned at retirement and the time value of money as well as the more familiar expenditures.

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4. The unit cost of the warhead depends upon when the question is being asked.

Thank you for your attention. I will now turn the podium over to Colonel Shaw for his presentation of the "Availability of Special Nuclear Materials."

Question and Answer Period

See the combined question and answer period following the talk by Colonel H. E. Shaw.

Colonel H. E. Shaw
USA (Ret.) AECOP

AVAILABILITY OF SPECIAL NUCLEAR MATERIALS

Now that Colonel Bruce has discussed the economic aspects of nuclear weapons production, I would like to open another door to the planning world with a short discussion of special nuclear materials availability illustrated by a few comparisons of this availability with some currently projected demand schedules. Planning of both nuclear materials production and weapons production is based upon input from the Department of Defense. This input consists primarily of two projections of the desired nuclear posture—that which is presented in the Draft Presidential Memorandum, called the DPM Base Case on the Nuclear Weapons Stockpile, and that which is contained in Annex C to the Joint Strategic Objectives Plan, referred to in this talk as the JCS Case.

Figure 1 portrays the demands in terms of weapons-grade plutonium over the next nine years. These demands would result from a translation of the stockpiles in these two projections into requirements for special nuclear materials. This figure shows only the plutonium demand, but similar demand pictures would exist for tritium and oralloy. As you can see, a spectrum of demands is portrayed—one, relatively low, resulting from the Base Case; and a considerably higher demand over the same period for the JCS Case. Because of the existence of this broad spectrum, additional planning cases are developed and utilized in a similar manner. This figure also shows the AEC Reference Case, which represents demands which would result from the Base Case plus contingencies listed in the DPM as possible over the period of the projection. This is an attempt, then, to reflect a warhead production schedule including these contingencies. Planning is normally based on many cases. Those shown are only three of the many, but they represent a reasonable spectrum of demand. Let me make very clear, however, that these cases are only planning bases; they do not represent committed programs as such.

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Figure 1

Demands such as these may be balanced against special nuclear materials availability. To do this, however, we need a starting point. Figure 2 portrays the various special nuclear materials on hand at the end of Fiscal Year 1969 for the weapons program. The amounts shown are held in reserve for future programs and are in addition to materials allocated for the Finished Weapons Stockpile, Build and Retirement Pipelines, Working Inventory, and Test and R&D Programs. Because the amounts of other SNM on hand are so small, only oralloy, plutonium, and tritium will be considered further in this presentation. Since the end of the fiscal year, there has been one significant change in the amounts shown.

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This illustrates a point quite well—that the weapons programs are no longer the sole users of special nuclear materials in large amounts; and, in fact, the civilian power program is projected to be the larger user of enriched uranium.

Now I want to present some comparisons of demand and availability—first for reactor products, and then for oralloy. In planning for production of reactor products, one must balance the production of tritium and plutonium as they compete for neutrons in the reactors. Because tritium decays significantly and plutonium does not, production planning is normally optimized on the tritium requirements to avoid an overproduction of this material. Then, the resulting plutonium production is

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Figure 2

compared with the plutonium demands. Because tritium demands vary from case to case, optimizing on tritium will produce a different production schedule for each demand projection. To illustrate, Figure 3 shows the tritium availability picture that would result from basing production upon the Reference Case utilizing the six reactors that are currently in operation. On the bottom of the chart you can see that the fiscal '69 reserve, because of the decay of tritium, would drop off in amount over the period of interest. To this reserve would be added the new production that would be scheduled to meet the total demands, resulting in the cumulative availability line shown as the upper line. Let us now compare this availability with some of the demands. Since the production portrayed on this chart was based upon the Reference Case, it should certainly provide ample material to satisfy any case in which there is a lesser demand. As we can see, it does this very nicely. Next is the demand for the Reference Case. After the initial reserve is used up, the cumulative availability and the demands are in balance through the latter part of the period. What would happen now if we were to compare this availability curve with the demands of the JCS Case? As you can see, there would be a significant shortage of tritium starting sometime in Fiscal Year 1973 and continuing from there. This illustrates what would happen if the materials production were planned for the Reference Case, but actual weapons builds approximated the JCS Case. As you see, we would run out of material fairly early in the period.

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Figure 3

As I mentioned earlier, we must now compare the plutonium that would result from this production schedule with the plutonium demands. Figure 4 does this. This availability picture for plutonium is similar to that which you just saw for tritium, with the exception that the reserve does not decay as tritium did; so it remains essentially a horizontal line throughout the period. Again, we add scheduled new production to this to account for the cumulative availability shown. Let us compare this with the Base Case. We see again that there is no problem of sufficient availability to meet these requirements. If we make just the right amount of tritium to satisfy the demands of the Reference Case, we end up with sufficient plutonium and retain some reserve. Let us compare now with the JCS demands. Again we see that we fall short, this time about a year earlier, and we would have a considerable deficiency of plutonium for the demands of the JCS Case. Again, though, let me emphasize that the production was scheduled on the basis of the Reference Case and it is not surprising that we are unable to meet the demands of the JCS Case.

Let us now look at the availability picture if the special nuclear materials production were based upon the demands of the JCS Case rather than the Reference Case. Again, we'll utilize the six production reactors that are currently in operation. Figure 5 shows the tritium production that would result under these conditions. Again, the reserve, when added to the new production, would result in the cumulative availability shown in the figure. Let us compare again, first with the tritium demands of the Base Case and then with the tritium demands of the Reference Case.

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Figure 4

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Figure 5

There would be ample availability to meet either of these two cases. Then, comparing with the demands of the JCS Case, we see that we have achieved the desired balance, starting about 1973, and can maintain this balance throughout the rest of the period. What happens, though, if we look at the plutonium picture that goes with this case? In Figure 6 you see the cumulative availability of plutonium based upon meeting the tritium demands of the JCS Case. The plutonium production has not dropped off significantly from the case you looked at earlier, the Reference Case—even though one would expect it to with the higher tritium production. This is because all nonweapons production was assumed stopped after Fiscal Year 1970 because of the very high demands of this case. An all-out effort was made on plutonium production after the tritium demands were satisfied, to attempt to satisfy the plutonium requirements for this case. If we compare this availability with the demands of the different cases, we see, first with the Base Case and then with the Reference Case, that we can meet these demands.

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Figure 6

In Figure 7, we see the availability picture for oralloy. The format is somewhat different in this case—primarily because oralloy is no longer in production. In fact, some would prefer that we not only not ask for any more oralloy, but that we return what we already have because of the projected requirements of the power industry. As you see on the left of the chart, there is a significant reserve at present. The base line, running across the center of the chart, designates that level at which production must be reinstituted in order to satisfy demands. Along the bottom of the chart, the Base Case is presented; and, as you see, there is no problem whatsoever in meeting oralloy demands for this case. In fact, the reserve increases generally throughout the period. However, the JCS Case represents a completely different picture.

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Figure 7

There will be a large demand for new oralloy production, starting almost immediately and continuing for several years. An interesting point which might be noted is that after Fiscal Year 1973, as the oralloy demands drop off in this case, we create a new reserve as shown in the upper right hand corner of the figure.

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If we compare the demands of the Reference Case, we see that, after an initial low demand period, most of the current reserve is utilized, but some reserve is retained and new production is not required.

In summary, then, we can draw several conclusions from the information we have just looked at. First, significant amounts of special nuclear materials are potentially available. We can also conclude that commitments are required in advance, early enough to reserve specific quantities of projected production, to obtain additional production or to maintain flexibility in the future. In some cases, as we saw, sufficient amounts cannot be made available under current operating conditions. We must remember that some things can be done with increased dollar levels, but others need time, regardless of the dollar level of the funding that may be authorized. Certainly a significant lead time is required, for example, to reschedule reactor operations to meet changes in requirements or to reinstitute separation of oralloy. Although the law as currently stated certainly gives first priority to defense requirements for special nuclear materials, things are occurring, particularly in the power industry, which will result in increasing requirements for some of these materials. As these programs proceed and more and more emphasis is placed upon them, commitments may be made which will be difficult to break for unforeseen defense requirements.

Question and Answer Period

(Questions directed to both Colonel Shaw and Colonel Bruce)

RUSSELL (USN, Ret.): You haven't said anything about the supply of raw material. I remember that, at one time, all our uranium came out of the Belgian Congo. What's the status of the supply of raw material?

BRUCE: To my knowledge, explorations have revealed that reserves of natural uranium have been increasing and at the present time there apparently is no problem in meeting the high demand for the Power Reactor Program. The numbers that we were using are based upon acquiring the feed at $8.00 per pound; there is some indication that the price may go up a little, but the availability apparently is there.

ETHRIDGE (Aberdeen): Have you estimated the number of new reactors that would be required and the approximate cost to meet the JCS requirements?

SHAW: No, we haven't gotten that far yet. The work that generated the numbers you saw in the figures was done only last week. We haven't had a chance to get at reactors yet. It will be a sizable figure, though.

ROWNTREE (NWC, China Lake): While I appreciate the ground rules you stated, your arguments for crediting the cost of materials for strategic systems, I'm afraid I must argue that that is not valid for the kinds of systems that we are discussing at this symposium. What we have been primarily discussing here is projected use of relatively small numbers of nuclear weapons in a context where we would not expect the economy of the United States following their use to be significantly disrupted. That was the dominant justification for your argument on the cost of the strategic systems. We would like to use the cost data that you supply for cost effectiveness comparisons. For example, I might wish to look at the comparative cost of destroying the targeted bridges in East Germany using Mk 61 bombs, nuclear Walleye, or conventional Walleye. In every case I would use up the materials in those weapons, so that for my cost comparisons I could not use cost on the assumption that I would turn those back.

BRUCE: I think you have a very good point. This subject was given a lot of consideration, as a matter of fact, at AECOP; and the problem is, I think, how many weapons you expect to expend. If you want to economically evaluate alternatives on the assumption that the weapons will in fact be detonated and material will be consumed, it is inappropriate to consider credits from retired systems. On the other hand, if only a few of the weapons are detonated, an economic analysis for the total picture makes sense, assuming that deterrents will prevail.

ROWNTREE: A cost effectiveness comparison by definition assumes use.

BRUCE: Well, I can only agree with you. If you want to compare two weapon systems that you expect to expend, then taking credits is not appropriate.

DOUGHERTY (LASL):

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BRUCE: This is predicated on an indifference value to the government.

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DELETED It's an indifference cost.

DOUGHERTY: What happens if you try to figure out what it really costs you to make it? Take people's salaries and the cost of the plants amortized, and so forth.

BRUCE: Well, as you know, what it costs to produce enriched uranium is a function of the power level at which you operate your gaseous diffusion plants.

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DELETED This is the penalty that you pay in enriching material and then blending it back to lower enrichment.

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SHAW: Let me explain why it will level out after 1980. The costs we are talking about are concerned with using uranium now on hand, not with the production of new uranium. If you build new plants, then the cost after 1980 must change with this.

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HICKS (Northrop): Commenting on Mr. Rowntree's point—if you take a weapon to obsolescence, in your consideration of cost effectivity your answer is still correct, because the Walleye becomes worth zero when it becomes obsolete, and then the next weapon has to be costed differently. This weapon still has some plutonium left that's worth money.

GIRARD (RAC): Has any thought been given to billing the civilian power consumers to fund increased production facilities so we really don't get into an oralloy bind—making this a real business than can develop its own investment?

BRUCE: The answer to that is "Yes." As a matter of fact, if the gaseous diffusion plants are not sold to private industry, and if the government has to produce this, they will produce it at a cost and charge it at a cost that will accommodate all of the cost including the investment of the new plants.

GIRARD: Well, I get the picture that the military users of oralloy were scheduled to be programmed out in order to accommodate these power requirements.

BRUCE: No, we don't want to leave that impression. What we're saying is that it may be more economical to use oralloy over a certain period of time and to delay the building of new gaseous diffusion plants; indeed this is being considered in the planning for the Division of Production at the moment.

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LOWRY (RAC): My question is prompted by the very high current interest rates DELETED ey continue, may change the trade-offs between fossil fuel and nuclear plants and therefore reduce that demand.

BRUCE: A very good point. The evaluation that we made on the cost of building new plants whenever they are needed was conducted on the basis of 7-1/2% interest money for new plant construction. If that is increased to 10 or 12%, then the value of oralloy will accordingly be increased.

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LOWRY:

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CRAWFORD (NWC, China Lake): How do you treat inflation in your analysis?

BRUCE: We gave this a lot of consideration. To those of us who have to buy groceries, it's clearly evident that they are costing more and more as a result of the inflationary process. This, however, is not true for all types of expenditures. Specifically, I think you'll agree that the cost to the government of producing electrical power is less today than it was previously. The same thing, we feel, applies to the production or the separation process in the gaseous diffusion plant. This results from increased efficiency because of improved technology, and we in our study assumed that such advancements would offset the inflationary cost of labor and so on.

CRAWFORD: You're assuming, then, that the plants which are involved here will become more efficient in the time you're talking about.

BRUCE: That is correct.

JACOBY (LASL): Have you considered the use of a centrifuge instead of a gas diffusion process for separating U235?

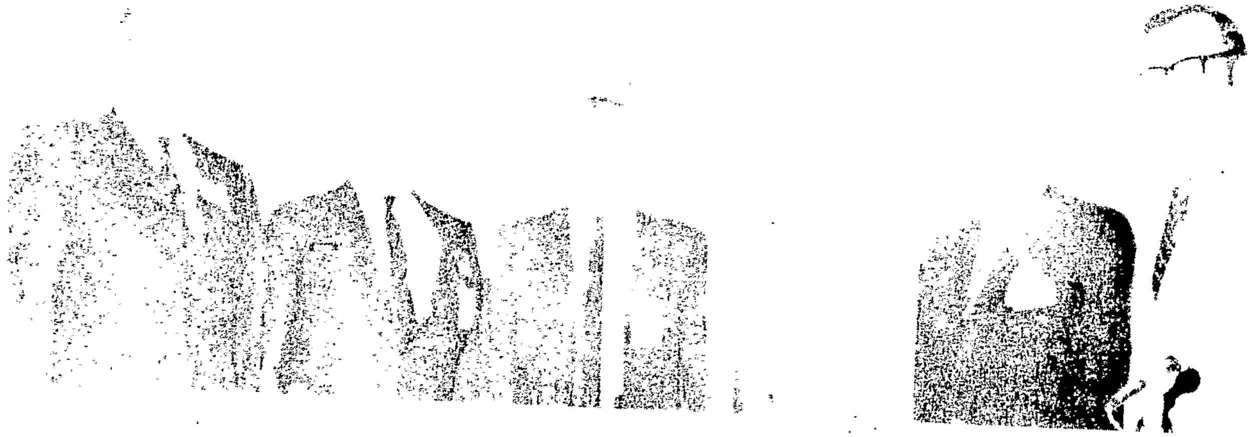
BRUCE: Yes, we have. This is being thoroughly investigated—as you know, it's highly classified. The results obtained to date suggest that, based on the values we're using and the way these rather large demands will have to be met, comparison with the gaseous diffusion plant indeed is the appropriate basis.

JACOBY: I'm considering your costing and the cost of a warhead to the government. It seems that what is important is how much the government has to appropriate in the next couple of fiscal years for this hypothetical warhead cost. You have to consider that the amount of oralloy or plutonium in the obsolete warhead will go toward reducing the cost of the present warhead.

BRUCE: What you're saying is that the decision making process is associated not only with the building of a particular new weapon system but also with the retirement of some other system. While this may or may not be the case, it's quite difficult to associate each new build requirement with an associated one in retirement. Therefore we found it more appropriate to consider each weapon system by itself rather than try to correlate it with another system.

SHAW: Let me add one thought to that. Keep in mind that these figures and these procedures are used primarily for the comparison of weapons-build alternatives, so that if you're comparing two or three builds, the input price is the same for any of the alternatives regardless of what you're getting out of the previously retired system. It's still the same material going into each of these alternatives, so on that basis it really makes no difference.

PANEL SUMMARY AND AUDIENCE RESPONSE



Hon. Craig Hosmer — Adm. James Russell — Dr. Harold Agnew — Lt. Gen. A. W. Betts — Dr. Albert D. Wheelon — Dr. W. R. Van Cleave

Dr. Harold Agnew (LASL)
Representative Craig Hosmer
Admiral James S. Russell (Retired)
Lt. General A. W. Betts (Chief of R&D, Dept. of the Army)
Dr. Albert D. Wheelon (Hughes Aircraft Co.)
Dr. William R. Van Cleave (OASD/ISA)

DR. AGNEW

We have here some distinguished guests who have volunteered to act as a summary panel, to give their own personal opinions of what they have learned, having listened the last two and a half days, and perhaps contribute to the subject based on personal reflections which they had before they came to the meeting.

I wish to give a couple of words of introduction. Representative Craig Hosmer deserves a great deal of credit for really making this symposium possible. He has, during the past couple of years, been in the forefront on the Joint Committee on Atomic Energy for questioning our position today with regard to tactical nuclear weapons. He took the initiative. We all owe him a great deal not only for this but for his continued contributions to our Atomic Energy program.

Next we have Admiral James Russell (retired) of whom most of you have certainly heard, even if you haven't had an opportunity to meet him—a naval aviator, a graduate of Cal Tech, holder of a position of responsibility in the early days of the Division of Military Applications in the AEC, and most recently, as CINC South, holder of a vital NATO command.

General Betts in a way is responsible for many of the facilities we have here at Los Alamos, and facilities we had many years ago. He was here in the early days of the Manhattan Project and throughout his career has continued to be a solid keystone for the defense establishment in the field of research and development.

Bud Wheelon is somewhat of a newcomer to this particular field and we are especially happy that he could be here. Before he took his present position he was Deputy Director, Technical Intelligence, of the CIA. I would say that he is one of those who have been very effective in melding technology into the intelligence community.

It is a special treat to have Bill Van Cleave here with us. Bill is on leave from the University of California, working in the Office of the Secretary of Defense, ISA. His is a clear, new voice in the councils of OSD. I have great hopes for progress in our subject field with Bill Van Cleave on board.

The way we plan to operate is that each panel member will make an initial statement, then I'll give each a second chance at it, and finally, we will open up to the audience for questions and discussion.

REPRESENTATIVE HOSMER

For the possible lack of another opportunity or remembering to do so, I'd like to express on my own behalf, and I am sure on behalf of everybody here, admiration and gratitude to Harold Agnew for being so effective a wizard as to put on a session like this. Just to prove that flattery gets nowhere, I am going to state that I was confused when he started out on Wednesday morning, and I haven't had any improvement in my situation since then. As a matter of fact, I think the carefully planned discussions were perhaps designed to leave us with some wonders and some doubts, and perhaps some resolutions toward clearing up a situation that is, at best, ragged. We have found out, over the period of the three days, that there really may not be much political credibility to the so-called tactical nuclear arsenal that we now possess. In addition to that, a suspicion has been aroused that there is no clear existing military doctrine for use of the arsenal that we have. When we get to those two points we get to the "chicken and egg" category—the weapons first, or the documents first and apply the weapons to them? In any case, unless we felt that a 12 to 15 year old arsenal is not up-to-date, that the obsolesence which has occurred during the period of existence is a factor to be reckoned with, I think that the situation may be escaping us. As far as the military doctrine goes, I think that, if at four o'clock this afternoon, the President were to give an order to fire nuclear weapons of a tactical nature in Europe, there would be the wildest confusion you have ever seen. There are so many questions left unanswered by the doctrine that has been described to us, not only in the military sense but in the political sense as well. For instance, we heard one of the speakers describe the difficulties in NATO. We had this business of 13 or 14 fingers on the safety catch at one time; then we worked around to a few selected fingers on the trigger. Right now I don't think anybody really can define just what the situation is with regard to command and control in this area. (I am sorry that most of our concentration has been on NATO, because there are other parts of the world in which there could be trouble.) But if we seriously regarded some of the problems of our European allies over the use of nuclear weapons on their territory, I think our doctrines and our preparations would have gone a lot further than merely scrubbing the stockpile and refurbishing it with something that probably would be more suitable. Not only do we have to worry about the fallout, but we have to worry about the long term aftereffects. When I see nuclear warheads zooming down into a bridge abutment on a river, I think not only about the explosion, but about the longer life isotopes that are going to be sitting down there, and the distributions thereof by water; and I recall that just a few weeks ago a lot of fish were killed in the Rhine River, and that the municipal water supply of much of Holland was involved. We would have to think not only about preserving our own allies' territory for use afterwards, but we should be thinking about the enemy territory. Assuming we won, we wouldn't want to pick up the territory in parts and pieces that would be unusable for decades ahead. In addition to that, we have heard about deficiencies in target acquisition and damage assessment on these division area size fields; and we have heard about vulnerability of our own forces and vulnerability of our logistics strength—thanks to Don Cotter who has carefully put these together.

In one of my questions, I asked why the Turks suddenly went negative on ADM's. Was that something politically internal or was it something by way of pressure from the outside? If we got serious about ADM's, their proper deployment and so on, what would be the response of the other side? Would they say they were not going to tolerate that and lay down the law then and there? Furthermore, if we get a stockpile that is usable, there is still the question of making it credible, not from the standpoint of its characteristics but from the standpoint of our intentions being known. If the other side is going to worry about your capabilities, he has got to have an idea that they could be used against him; otherwise he won't be deterred. If we are serious about a nuclear tactical capability, particularly in Europe, I think we should take that long list of things that we really get upset about and talk about them in obvious terms.

We haven't brought up the Nonproliferation Treaty. You recall we had trouble recovering after the handcuffs were put on us by the Limited Test Ban Treaty, but by spending enough money we have been able, in the last couple of years, to get a great deal of information. Under the Nuclear Nonproliferation Treaty, you have two separate problems to worry about in connection with tactical nuclear weapons. Despite all the PAL systems you can put into these, if the treaty is observed you still have to keep them under your own custody and control. So we have to build a lot of things into these weapons that you wouldn't have to build in otherwise. When you do that, however, you put yourself in the position of not being able to respond if the Nonproliferation Treaty falls apart. It won't be very long before there is a new "proliferee," and there will be another one after that. Whether the Nonproliferation Treaty is going to be able to survive this recurrence of proliferation is a serious matter. If it doesn't, then we are free to proliferate and we are free to decouple if you want to put it that way, either in the Far East in connection with Japan, or in connection with NATO. Circumstances might dictate that we should decouple, or the treaty might go down the drain and we would have to make other arrangements. I don't know how quickly we could respond in the form of hardware to such situations with the constraints that we have to build in to live with these things. I just bring that out as a further possibility for the designers to have in mind.

ADMIRAL RUSSELL

When I joined the Commission as "No. 2" to General McCormack in the Division of Military Applications, in June 1947, we were in the transition from a wartime endeavor under General Groves to a civilian commission. We had two weapons. They were known as the Fat Man and the Little Boy. We did our best at that time to visualize everything that might come in the particular form of nuclear energy, and Jim McCormack, Paul Price, and I made a great thrust to get tactical nuclear weapons developed. This was 22 years ago. I come back now and find that we do have tactical nuclear weapons, and there are some good ones, but their design is about 15 years old. I am proud of this progress, but I really think it should have been greater. The Atomic Energy Commission split away from the military completely, which, I am sure, was the correct thing to do. It was the will of the people and expressed in Congress; but I think that the AEC, Los Alamos Laboratory, Livermore Laboratory, Sandia, and other elements of the Sandia Commission must live as closely as possible to the realities of military planning and training—military fighting, if you please. That is why I am so pleased that Harold invited me here to this conference. It has given me a chance to see where we stand, perhaps make a few suggestions on where we might go from here. Yesterday, our good host said "Where is the Navy?" The absence of a formal program on the part of the Navy may be taken in two ways—one is that they have what they want, and the other is that maybe they don't care so much about this. I have made a little personal research in this, since I am a graduate of the "dark blue uniform school" as well as Cal Tech, and I find the contrary is the truth—they are very much interested. Not only very interested, but a little fearful that a useful set of atomic weapons applied to warfare at sea might be taken away from them. I say to this, "God forbid." As you know, the Navy carries a regular nuclear arsenal in their aircraft carriers, but that is just the beginning. The Navy has a very serious problem. The fellow who doesn't have the upper hand in power at sea usually resorts to action under the surface. The Germans have done this in two world wars and the Russians until very recently have done this also. So any submarine warfare is of great concern to the Navy. We have, as you know, what used to be called Lulu and now is called Little Lulu, an atomic depth charge. Also we have Subrock and Asrock, antisubmarine rockets with a nuclear warhead, and a few others for the antisubmarine game. Then in the antiaircraft locker, we have Terrier and Talos nuclear warheads. In our attack weapons, we have Walleye and Condor.

I am glad to see that Walleye is getting support from the Air Force. We got some support awhile ago on the F4's too. We got support on a few other weapon systems to develop out here at what is now called the Naval Weapons Center, (formerly called NOTS, China Lake). These are weapons with atomic tips. If a war starts and the other side uses tactical atomic weapons, can you imagine the disadvantage to our fighting men if they don't have them too? This may be poor logic, but I feel that we must have them.

I am very much concerned about the command and control. I have seen this in action. It is a little stale now, but I was honored by being Commander in Chief of the Allied Forces in Southern Europe of the NATO Command. I had three countries to defend—Italy, Greece, and Turkey—and three more different countries you'd never find. Their people are quite different in characteristics and in religion; they don't like one another. But their dislike for one another is not as great as their dislike for the great Bear up to the north.

I don't understand what General Cowan said about the ADM being suddenly cut off by the Turks. Having been out in that country and knowing the temperament of the Turk, I cannot believe it was because of any threat from Russia. Remember, the Montreux Convention for the control of the Bosporus and the Dardanelles was signed in 1936. At the end of World War II, the Russians said this treaty was outmoded and they were going to revise it and just take over. The Turks said in effect, "You'll do no such thing. We are going to observe the terms of that treaty and we strongly recommend to you that you do likewise." This is the language the Russian understands. The Montreux Convention is still in effect controlling the waters of the Black Sea, the Bosporus and the Sea of Marmara.

The Turks are among the best soldiers in the world, in spite of the fact that as many as 50% of the draftees require instruction in reading and writing. They have 24 months of active duty. I observed them driving tanks, firing 105 mm howitzers, and doing all the other things that a soldier should. Not only that, but a mother in Turkey is extremely proud when she has a son in the armed services. Out on the country roads, if a military jeep goes by, the inhabitant usually stands at attention and salutes. He is not military but he is very proud of his country, and of his armed forces. I remember what Dr. Foster said yesterday about the determination of which was the greater enemy of the American people: the military/industrial complex or the Russians. He wasn't quite sure which way the settlement was going to go. I do hope that through meetings like this, the military can be better understood, and perhaps we can regain respect. I have been greatly privileged in the last two years to be recalled to active duty twice. Once I was called up to review safety measures after two disastrous fires; and last fall, I came back to the Secretary of Defense to be on an Evaluation Committee along with Dick Garwin. I was tremendously impressed with what the American youth can do.

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I was mighty proud of the soldiers in Vietnam: I was proud too of our Air Force operating in Vietnam and from the sanctuary of Thailand—God bless the stout allies. I was proud of our pilots who were leaving the deck of the carrier and going over and taking about half of the raids which were made against the extreme north in Vietnam. There is one point I'd like to bring out, stemming from my experience during the Carrier Safety Committee. That is, when you design weapons, please remember that there are advantages aboard ship—storage, for example—but the weapons are terrifically concentrated where they are stowed. In the old days, we used to park an airplane on the flight deck, bring up a bomb, put it on the wing, and then insert a booster and then a fuze. Those days appear to be gone forever. We now have an all-up round that has not only the explosive, the booster, and the fuze within it, but also a rocket motor and an igniter. So it is that the Navy requirements for weapons are just a shade different from those of our brother services who have dispersion ashore, and an explosion means only one airplane perhaps. We had one rather bad fire after the formation of my Safety Committee. It was on the flight deck of the Enterprise, and was caused by a seaman backing an air-start cart with turbine exhaust to within 24 inches of a 5 inch rocket nose. Witnesses saw the paint on the warhead of the rocket change color before it blew.

I do hope that I can convert everyone of you to the necessity for keeping forces at sea. I explained to Dick Garwin last night that the system which he's advancing would never get to a theater of action unless it were in Canada or Mexico, or unless we had control of the surface of the sea. That is the Navy's mission, and tactical weapons assist in that mission.

To conclude, I would like to express strong support for this sort of conference.

GENERAL BETTS

My overall impression is that I have been here before. It goes all the way back to the early 1950's when, as a light Colonel on the Army Staff, I did some of the first "back of the envelope" sort of analyses to try to persuade the army that nuclear weapons had a role to play on the battlefield. Hearing about the kind of employment studies that are now being made, we must recognize that we have come a long way in 20 years in terms of learning more about capability limitations of these weapons. Not only has the technology of the weapons advanced tremendously, but we now can play these games by the hundreds on a computer model and have a lot better feeling for what can or cannot be done. There have been many optimists on the platform, and I think I am going to add a note of pessimism. At the conclusion of Colonel Fair's description of CDC's TACTO study, General Burchinal commented that he felt there wasn't a chance of getting the Europeans to accept the possibility of fighting a limited war in which nuclear weapons are used. I have been involved in, or acquainted with, all of the studies on the use of tactical weapons that have gone on in the Department of the Army, and in many cases, in the other services.

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That's slightly reminiscent of some of the things Colonel Fair was suggesting in the TACTO study. The word we got back from the Command elements of the Army Staff was that they just couldn't afford to use these weapons over there, they needed to hold all they had in reserve in case the Russians started something and they needed them for strategic purposes. It was also very clear, although I cannot document it, that it was not politically acceptable. So from then on, the studies that were done were pointed at showing all the reasons why we couldn't find targets, why we couldn't get the authority to release quickly enough after having pinned down a target, and, in sum, why we would not be able to make effective use of these weapons. I submit that this accounts for my pessimism at the moment. We have created the model that describes how we will use these weapons, and over many years of detailed analysis we have considerably improved that model. This model is completely hypothetical until we get the political leadership to say that we will indeed use nuclear weapons. As you are all aware from your own familiarity with the scientific method, when we have these great unknowns we create a model, we plug in all the data we can find, and sooner or later do some experiments to prove or disprove the model we have created. I am not proposing that we go out and try to prove or disprove these models, but until the situation arises when we can plug in the kind of data necessary to validate or invalidate the models we have made, all we can do is go ahead as we have in the past. We must do our level best to establish capabilities and limitations, and show logically that tactical nuclear weapons have a very important role to play. We cannot possibly face a potential enemy like the Soviet Union with their nuclear power unless we are equally well or better equipped. About all I can say in summary is, let's keep driving ahead the way we are going, trying to do better all the time. We will never really convince ourselves that we know what we are doing until the model is either validated or invalidated.

DR. WHEELON

I am really not a tactical nuclear buff—as a matter of fact I am not even a nuclear buff. I have learned a good bit about this field from the meeting here, and I'd simply like to say it has been very well done. Maybe, since I haven't been here before, you'd be interested in my impression of what this field is all about. First of all, it is pretty clear to me that we have an impressive technology available for creating a new and far more acceptable tactical arsenal. The ingredients are really weapons, the way in which their effects can be modulated or shaped, the delivery means that are now becoming available, the accuracy of those delivery means, and the production capability both in weapons and fissile material. I don't think there is much point in belaboring that, except to say it is there for the using. It is also pretty clear to me that policy decisions have effectively precluded serious consideration of these options for quite awhile, both in the initiation of weapons programs and their delivery and in the kind of thoughtful on-going planning for their utilization. I have the impression that this planning has just begun in a serious way in the last year and a half. I think this affects the completeness of the story that we have to present. I was interested yesterday to hear about the planning of how we might initiate a first strike using tactical nuclear weapons. I did not hear a discussion of the reciprocal problem of what happens if they strike first—and that is a mighty important issue. What happens if it begins in a ragged way? That is part of the mature analysis that it takes time to develop, and I hope that the present studies mature along those lines. One of the most distressing things about this formal policy is that it has precluded a frank discussion of the possibilities with our NATO allies. We are unwilling to tell them what might be, and on the basis of what they don't know they are quite unwilling to encourage us to proceed. There is something else that hits an outsider for the first time, and that is the marked asymmetry reported in the Russian tactical nuclear posture and our own. The results of our war games indicated that we needed a lot more artillery shells and a lot fewer missiles, and yet they have apparently forsaken artillery completely and have gone over to extensive rocket delivery means. I guess it is important to know what that means. Does it really mean that they are going for an offense rather than a defense? Does it mean that they intend to strike first rather than respond? I don't pretend to know, but I submit that someone ought to worry hard and long about this matter. Maybe it also means that we don't fully understand the problem. Now, the final impression I have is that the tactical nuclear policy is not likely to be clarified very soon, and that is too bad. I think the uncertainty as to how we would use our weapons in time of need is going to be an uncertainty for both US and Soviet commanders and I think it complicates their lives quite a lot. We have to try to find ways to use that uncertainty to our advantage rather than our disadvantage. That sounds like a contradiction, so I'll come back to it and give you a "for instance" as to how it might be done.

General impressions aside, I'd like to talk about ADM's because that seems like an interesting proposition. I would have thought that a defensive use of ADM's in one's own land against an invading enemy would be about the most acceptable utilization of these weapons, and yet I find just the reverse. It seems to me that our present policy of nonimplacement just about guarantees that they will not be used in case of attack. Secondly, concentration of most of them in rear stockpiles really invites a preemptive attack by the long-range missiles—MRBM's, IRBM's—from the Soviet Union or from satellites; therefore, I don't think they are going to be with us when they are needed. Another issue is, what about the loss if they are overrun and not used? I just think that is a red herring. I think the design information the Soviets would gain from capturing some mines would be very small potatoes compared to the political loss that we would suffer if West Germany were successfully overrun. I don't think we are weighing these on the same scales.

It is time for me to come back to my previous assignment of trying to turn our uncertainty to an advantage, and to do this I'd like to steal from a field that I think I know something about, the strategic game that Fred Payne and I have worried on a lot. This is the idea of using dummy holes to play the shell game with ADM's the way we have talked about playing the shell game with ICBM's, having more holes and more silos than missiles. To facilitate this discussion I'll put a cartoon on the board; that dotted line up there is something that the Army fellows call FEBA—that is supposed to be the front—that they are going to attack downward over. The general idea is to have a series of predrilled shafts, placements, or whatever you put an ADM in, fairly uniformly distributed over the area you wanted to defend. Then you put, at random, honest-to-goodness nuclear demolitions into only a fraction of those holes, and put old fashioned HE mines into the rest of them. This is a ballistic match problem; they have to fit in the same hole, but I bet we can solve that problem. The rest of the story for those of you who aren't strategic boss is to know that these implacements, the things that are dropped in the holes, look exactly alike. As a matter of fact, the crews that do the replacement don't know whether they have a real one or not because they work through a pass-through window over in a building. They back a truck up to a pass-through window, and a crew which is cleared passes through real ones or HE versions at random. One would rotate the shells from time to time, and you have the option of changing the pattern regularly. There are some fairly obvious advantages. First of all it allows you to concentrate these things along particular routes, they don't have to be scattered uniformly. Second, it reduces local anxiety, at least it should. After all, only one in ten holes actually has a nuclear warhead, and the farmer ought to be worried only about one-tenth of the time, and maybe that could be exploited in some useful way. It also allows you to actually pull them all out in secret without the Russians really being sure they are all out, and you can put them all back in without his necessarily knowing it. It also has a kind of attractive feature to me in that it precludes the Pueblo procedure kind of action against a single pre-emplaced ADM. The special advantage to the American commander is that he doesn't have a discontinuity in his warfare; he doesn't have both a nuclear and a nonnuclear capability. If he doesn't get permission to fire the fraction F, say the 10 percent, of all the holes, then he can still fire the other 90 percent and they are in about the right areas. If he does get the "go," then that other 10 percent has a lot more effectiveness. So it isn't an either/or, it becomes an add-on or increment to the existing capability.

I had one other suggestion, and that is that you could go from just plain old buried mines to pop-up mines. I guess those of us in the strategic game know how to make missiles that only rise about 100 feet in the air, and it might just be that if you want to have an enhanced antipersonnel radiation device as a warhead. That might be a better way of doing it rather than having it go off under ground. I don't pretend that this is a very military, attractive scheme; it simply gives you an example, if you will, of a way in which the uncertainty of our policy applications might be turned to advantage. Certainly, looking at it from the other side of that dotted line you have a severe problem.

Having looked a little bit at ADM's, I asked myself a second question: "Why do the trigger and the warhead have to be collocated?" And I guess I told myself that they really don't. As a matter of fact, you could bring the weapon in by a number of means. You could shoot it in with an artillery piece, you could bring it in with an airplane and drop it on the point, you could shoot it in with a cruise missile. You could do quite a few things to all these presurveyed points. The trick is to know when to put it in and when to have it go off. There is a classical way to do this, and that is people and radios. There is nothing wrong with that system. The only trouble is that they get rolled up pretty fast, particularly if you want to withhold until the first wave has gone by. So the next thing I'd like to draw is some of the work that was done on behalf of South Vietnam, and that is the DCPG program—it is known by lots of names. The basic idea is to have battlefield sensors—a series of acoustic and seismic detectors of very small size with radio means that could, in fact, indicate the presence at a point of trucks or armored columns, etc. Everybody knows something was wrong with the system, the way it worked as a barrier system in South Vietnam; but I don't think that has anything to do with this discussion. I think that these battlefield sensors have a real relevance to the problem at hand. I think they can provide the "when" at the XYZ coordinate for delivery, and I submit that we have some homework to do on this subject.

My last comments approach the political. I just have to say that I think it is unlikely that our SIOP will be discharged in response to tactical operations. I think that for two reasons: (1) our strategic force is pretty well checkmated if not dominated by the Soviets, or at least very soon will be; and (2) the Russians are going to be very careful not to trigger our SIOP so as to escalate it. I think they will continue to conduct themselves in such a way as to keep their actions below our threshold or ascribe them to someone else. If that is really true, it seems to me that we are deceiving ourselves and our allies. I think that our SAC, Polaris force is unlikely to affect the course of tactical events; I think it is checkmated. Having given that gloomy outlook, I'd like to say it would be nice if we had the IRBM/MRBM force checkmated. I think that one is a flexible element in their force, and it seems to provide an effective unilateral threat to the survival of NATO. I think it would be most encouraging if NATO had a counterbalance of her own to that threat, one which would leave our SIOP capability free to deal with the threat to our country, namely the Soviet ICBM force. That is not a plug for MRBM; it is a plea to be honest with ourselves about the extent to which our SIOP is really prepared to be committed against two targets, the sum of which is bigger than we can handle.

DR. VAN CLEAVE

I too have a certain sense of having been here before. I recall symposia four to five years ago on Tactical Nuclear Weaponry. Virtually the same opportunities and technology were presented. I do, however, detect one change, and that seems to be a change in receptivity towards modernization of tactical nuclear posture in the United States. I don't really know, to be honest, whether this is because there is a new appreciation of the possibilities and opportunities coupled with a new concern over some political and military problems which these types of forces might solve, or whether it is primarily a matter of the different composition of the audience. I don't know whether this was deliberate or not, but I recall a series of symposia held at Sandia in 1965 that seemed to me, speaking as a political scientist, to have been badly overloaded with political scientists, and to have been greatly dominated by a pronounced firebreak philosophy. My remarks today are going to reflect a transition period. I have been an outside student and therefore a critic of OSD policies in nuclear weapons; and, now that I am a member of the OSD ISA that I have so often criticized, I still have not passed the transition zone. My remarks, therefore, should be taken as personal ones and not ones that reflect, in any sense, OSD ISA views and certainly not OSD views. On the other hand, I am not going to dilute my own views as a student of the problem simply because I am now a member of OSD ISA.

Why hasn't serious consideration really been given to the options we have been talking about today? The problem is that we have had a circular type of situation: A certain philosophy led to a policy which maintained certain types of tactical nuclear weapons in the arsenal, which produced certain collateral damage figures, which reinforced the philosophy that produced the policy that kept the weapons in, etc., etc. Somewhere in there, the circle simply has to be broken, if there is to be any chance of improvement in the tactical nuclear force situation. To elaborate just a little, in my own view, analyses often served mainly to rationalize the existing conclusions. The policy then led to a deliberate retention of old weapons and in essence froze 1950's technology in the laboratory—high yield for battlefield combat purposes, very dirty, very indiscriminate, very inflexible. Not really what one could call a tactical nuclear weapon, but rather a nuclear weapon designated for tactical use. Why these types of weapons? Simply because the firebreak philosophers wanted them. There was a strong belief that any type of nuclear bang was about the same as any other type and, to quote Gilpatrick, "Once you start using any kind of nuclear bang, I just don't know how you can build any limit into it." Thus, one didn't want to see a nuclear weapon usable, and this was rationalized by claiming that, after all, this is the best deterrent and the deterrence is the name of the game.

But is this really the way to provide the deterrent? Is it the way to meet some of the military and political problems that we are encountering with dismally increasing rapidity? In my view, it isn't the way. My own feeling was very well expressed by Dr. Hudson on this, this morning, in the statement that a useful force, at least I'll say below the strategic general thermonuclear warfare level, is the best deterrent. We went beyond that, I think. We worked hard to reinforce the incredibility by continually emphasizing non-use. As Bernard Brodey once said, if we are not going to use them the least we can do is shut up about them rather than continually advertise them. The theater nuclear force posture certainly didn't deter or help deter anything in Vietnam. In Europe, yes, we have had deterrents, but I rather doubt it was because of the obsolescent tactical nuclear weapons of the firebreak philosophy forced upon us, but because of our numerical superiority in both tactical nuclear forces and strategic offensive forces. Now the question is, how good a deterrent will this tac nuc posture provide if we no longer have parity, and perhaps are inferior in tactical and strategic weapons? It might cause a checkmate only. Even with parity, based on assured destruction, which boils down to mutual vulnerability, how credible really is our current tactical nuclear force and our current deterrent? The weapons, then, resulted in these calculations of intolerable or at least unacceptable (I think one ought to distinguish between the two a little more carefully than one tends to) collateral damage, as we kept telling the Europeans. This reinforced the incredibility and the difficulty of use of any of these weapons, which in turn led to problems of policy and strategy. Views in this area, public and otherwise, respond to the information given and to the weapons given. I don't agree that the problem of European views about tactical nuclear warfare is an unsurmountable thing—European views have largely been a mirror image of our own. Moreover, the throes of the NATO Nuclear Planning Group seem to me a reflection of concern over deterrents. Further, I think views change with perception of requirements and of alternatives available. Views aren't static in this sense. It's a trite thing to say, but I think the world is changing in relevant ways that have a bearing upon our tactical nuclear policy. I have heard here statements about tactical nuclear requirements, and about necessary modernization of the stockpile. I think General Burchinal's statement was eloquent; General Cowan and Dr. Shreffler pointed out new views of requirements, of new flexible, low yield, discriminate, and, as some people claim, nuclear weapons. I think the problem is one of getting both the civilian and military personnel in DOD to be imaginative and progressive enough to tackle these problems. I am not suggesting that this is easy, and I am not even suggesting there is necessarily any solution. My limited experience tells me that it is going to be very difficult. I think one of the problems is one of getting a really thorough, objective, up-to-date review of tactical nuclear opportunities and requirements, and I personally have an uneasy feeling that the DPM and the NSAM processes aren't going to provide it.

I therefore welcome any suggestions from the audience of what might provide it. I will say that I believe the climate has changed, not only in the world but in OSD, and I think now is the time to discuss the subject again, to be heard and to get moving, because otherwise there could well be another long, dry spell. You might be surprised at the way your recommended requirements are received in the new OSD; at least in one part, I think I can promise a new approach and a new receptivity. I might also point out that, 12 years ago, two authors, in quite well received books, argued that there is nothing inherent in the wide range of nuclear weapons that renders them incompatible with limited war or tactical combat operations. They suggested that the adaptation of these weapons to limited war and to credible, flexible military operations was the most crucial task facing policy planners. One can make the same statement in 1969. Those authors are now on the NSC staff; let us hope this reflects a change in receptivity to their ideas.

DR. AGNEW

I'd like to go back to what Representative Hosmer said about our lack of what you might call rules of engagement, or rules of the road. I think the Soviets have such rules; I think we understand them. They have made it very clear that if any aircraft, for example, trespasses over any of their airspace, they shoot it down. Such incidents have not escalated into an all-out nuclear war. I have the feeling that even if they were required to use the nuclear warhead for this it would not have escalated into an all-out nuclear war. What they are essentially doing is applying whatever force is necessary to implement whatever conditions they have imposed on anybody. I think that tactical weapons could indeed be employed this way with the vastly superior delivery systems which are becoming available, using very low yields, and limiting the use of these particular weapons with regard to geography, and political and military objectives. In the past, we have enjoyed a great superiority, certainly in strategic forces, tactical forces, and technology. I think Vietnam has made it clear that just a little technology goes a long way; but I think we will no longer be able to refrain from using all of our technology. If our political leaders want certain objectives to be pursued in a certain way, it behooves them to be fully aware of the technologies which our Armed Forces are going to have to employ. I don't think they should essentially tell the military establishment what they want done and how they want it done; the time has come for them to state what political objectives are desired, and then let the military say whether or not they can do it under given conditions. Then if it turns out that the objective can only be attained by using certain types of technology, the political leaders must decide whether they want to continue the attempt. Passing on to what Dr. Wheelon was talking about on ADM's, there is one point that I think he didn't mention. As you are aware, with our allies in NATO, systems such as Honest John, Pershing, the 8-inch howitzer, and tactical bombs on aircraft, can be delivered and utilized by our allies. They, themselves, can deliver these once the President of the United States has authorized them to do so. However, in the case of ADM's we have a unique situation: only the US can emplace and detonate them. I would submit that, in the case of this particular weapon, the individual who presses the button should be a national of the country where the detonation takes place. I think the US could be in a very bad position, even after a military success, if we could be blamed for "spoiling the landscape" and causing other problems discussed by Representative Hosmer.

I was a little surprised that, in the discussion of the survivability of our tactical air force, no one jumped up to defend the V/STOL program more vigorously. I think for the airmen here, of the Navy, Marine, and Air Force, the V/STOL will be the solution for appropriate survival forces. I am happy to see that, at long last, after a long battle, the Marines have a program to start with a small group of 12

Harrier V/STOL aircraft to see just what advantages will accrue to them from this type of operation.

REPRESENTATIVE HOSMER

Well, I have been in disagreement with General Betts' pessimism about a possibility of refurbishing the stockpile, and in agreement with Bill Van Cleave's optimism about it. We have heard about the nuclear Walleye and the nuclear Condor, and I think Carl Walske may have some other interesting items for us one of these days. We are apparently starting to refurbish the tactical nuclear stockpile, but the question is, with what, and how fast. We find we need something to improve target acquisition and accuracy. Then we need tactical nuclear weapons which will carry out certain specialized activities without the collateral effects that spread across the continent. We want cleanliness, we want earth penetration, and we want reduced or enhanced radiation, and, in some cases—not mentioned so far—we would like enhanced thermal. In other areas you'd like enhanced blasts, because the enemy might be roving around in a forest, and you'd like to confront them with nothing but big sticks to try to crawl through. Then in other areas you might like a tremendous light release, blind the opposing forces for awhile, assuming that you get good enough control of your own troops first. There are any number of specialized features that you might work on. I think, in any case, you have to hold the collateral effects down and that means holding the yield down. I just don't like to think in terms of using tactical weapons of more than 50 kilotons, except under certain circumstances. That gets us down now to an area of discreteness, into an arsenal of weapons that you have some particular uses for, and you can start to develop doctrine for use. You can anticipate the areas in which you might be using weapons and start to acquire data on the geology, the soil composition, etc. Although I agree with Harold Agnew's theory that you have to have the host's as well as the guest's finger on the trigger, perhaps you can't do this with very limited effect weapons. Yesterday I asked a leading question of Major Murtland, more or less to build up to this: what would he like to have that he hadn't heard talked about lately. And he described something that we hadn't discarded, the Davy Crockett. When you get down to those ranges, I don't suppose that you would take this host trigger philosophy as seriously as you would for some other type that might do more damage.

ADMIRAL RUSSELL

I would like to supplement something I said on the design of a nuclear weapon—I hope you understand that when we use nuclear weapons in the field they have to be reasonably simple. In Korea, a national emergency was declared, and those in Service stayed on until the end of the war. But in Vietnam we are fighting a war under peacetime conditions, and if you train, for example, an ordnance man in the Navy, he completes his enlistment, say, in four years and he's gone. You train another man. This is quite a burden. So I think we should recognize the fact that weapons employed by military people should be as simple as possible. I'd like to go back in history.

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/It was suddenly decided that this wasn't good, and

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a Polaris submarine, deployed in the Mediterranean, was offered as a substitute for the Jupiter missiles.

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I wish I could share the enthusiasm for V/STOL. I wish the Marines well, and I hope it works. Perhaps we have now come to packaging the amount of power it takes to get off the ground vertically, but I don't know.

GENERAL BETTS

To paraphrase a remark—my pessimism was greatly exaggerated. I fully share Congressman Hosmer's belief that the atmosphere has changed, that indeed we can refurbish the tactical nuclear stockpile. That was confirmed by the remark that we are to have approved, or have had approved, Phase III for a couple of nuclear projectiles. The point of my pessimism was that I don't see the likelihood of our being able to change the political leadership attitudes toward whether or not there is a clearly definable difference between using a low yield tactical nuclear weapon and using a large yield strategic weapon. This in spite of study after study clearly demonstrating that there are definable differences, and one can indeed build weapons with reasonable accuracy, very low yield, or suppressed radiation for the appropriate application. Nevertheless, I go back again to the one time when I thought we had a clear and defendable application in the Korean war, but the political hurdle, getting somebody to face up to that first nuclear weapon, was absolutely insurmountable. Perhaps it is best illustrated by a story told by Mr. Flood in the hearings of the House Appropriation Committee, telling about a couple of his colleagues discussing the vote on the ballistic missile defense. One had voted for it, even though he had been rumored to be against it. So his colleague asked him, "Did you finally see the light?" He replied," No, I finally felt the heat." I am afraid that is the practical fact of the matter with respect to the question of tactical nuclear weapons. Yet, I would not change what we are doing; I still believe that to have the right force, properly structured with modern weapons, with the evident intent to use them, amounts to a great deterrent force, and we should do our best to maximize that capability.

DR. WHEELON

I have nothing to add except to agree with your addendum to my ADM remarks. I think our ADM policy is just upside down.

DR. VAN CLEAVE

Just a couple of remarks. I agree with General Betts on the problem of changing the political leader's view on the firebreak: and I agree that there is a distinction between using very discriminate low yield nuclear weapons and other nuclear weapons. I don't want to minimize that difficulty at all. I also think that there is no reason to refuse to modernize the stockpile.

I want to address just one thing that disturbed me. It was the statement that it doesn't make much sense for us to have low yield, clean, discriminate weapons when the Soviet Union doesn't have them, because the destruction will be the same when we get into this type of tactical nuclear trade-off. This smacks to me of the argument that symmetry equals stability, equals advantage for both sides. I think it neglects badly NATO's political advantage in having usable weapons—which seems to be translatable into a better deterrent, a more credible one because one can, and therefore probably will, use the weapons more effectively. I think it also neglects possible military advantages that these might give even in a confrontation or conflict in Europe. That depends upon your own scenario and I am not going to get into an argument on that. You build your own scenarios from your own assumptions. I don't think that one can simply assume that a certain scenario will be obtained. I think that there are great differences between these and the postulated Soviet types of tactical nuclear weapons. This might, in itself, work strongly to our advantage, because it might mean that the clear decision to escalate this qualitatively different type of nuclear exchange is left up to the Soviet Union, and it is not always advantageous to have this type of initiative. To make that clear, you might turn it around and ask what we would do if, in a military conflict with the Soviet Union, we were offered that choice, because the Soviet Union had presented us with a very effective and discriminate, clean, counterforce tactical nuclear strike and we had nothing but 30 to 50 kiloton dirty weapons. It would be a very difficult decision to make. Furthermore, I am not sure what the Soviet Union is or is not developing in this area, and I don't think anybody else is either. I don't think we have any persuasive evidence that the Soviet Union isn't interested in this family of weapons. Lastly, I think the "symmetry equals stability" argument ignores the case in which the opponent is not the Soviet Union. I think we are hung up a bit on the model of the tactical nuclear war taking place in Central Europe with the Soviet Union as the opponent. I think we have overemphasized, almost to the point of preoccupation, the tactical nuclear roles in Europe rather than elsewhere in the world; perhaps this reflects some feeling of fair play that one ought not to use these things against someone who is inferior. I find that very curious.

Audience Questions and Discussion

GARWIN (IBM): It seems to me that modernizing the stockpile of tactical nuclear weapons is not a great emotional or financial problem. If we spend money on that, it is just money we won't be spending on something else, and we will have a better, more responsive, better controlled stockpile. However, it won't help the situation in Europe very much. Our bases there are extremely vulnerable, so that we could be put out of operation very quickly as an effective force before using our weapons. We would have to have a different basing structure; the Air Force requires dispersion of some kind, or at least the possibility of dispersion. I certainly agree with Harold Agnew, that for the nuclear delivery role the V/STOL aircraft, as the Germans see it also, is the answer. On the other hand, if one delivers a weapon once in this semistrategic manner, one might also ask whether their missile is not more appropriate; and here, too, I can't get very excited about the possibility or dangers of the midrange ballistic missile force. I think that it would help NATO to grow up if they had a force like that of their own which threatened at least the Western Soviet Union, and would make a deterrent very much more credible than the one which we claim to supply for the Western Europeans.

I'd like to take issue with General Betts a bit—I believe General Betts claims to have made the case for nuclear weapons and that the political leadership is just in arrears for not recognizing this. But I think that what we heard on the possible application of tactical nuclear weapons in the 1972-1978 period doesn't make that case at all except by assumption and repetition. I think it is ridiculous to assume that the Soviet forces, when they meet the first nuclear weapons, are going to fall back in disarray and think for one to three days. What is going to happen is that they will have a plan, even if they don't plan to use nuclear weapons at the beginning. They will have plan A and plan B—plan A, in case they don't meet nuclear weapons, and plan B, in case they do. One last point—I personally don't see any undesirable features in the use of one or more strategic missiles from the United States to deliver a nuclear weapon for tactical purposes. I think that if we can have an expeditionary force of strategic missiles of this type, it is more acceptable to our potential enemies and allies and spectators than if we deploy these things widely all over the world. I wonder whether we are not deceiving ourselves in expecting that the Soviet Union would not use remote delivered nuclear weapons of this type by long range rockets to accomplish limited goals.

ROWNTREE (NWC, China Lake): This is mostly for Dr. Van Cleave. I'd like to express my appreciation to you and Mr. Hosmer for noting what I believe to be the overemphasis on the European situation in this meeting. But I'd also like to point out that some of the problems we have been discussing aren't restricted to the nuclear weapons community. They are equally relevant to the conventional weapons community, in that our primary problem is to so structure and arm our military forces that we can apply them in conflict situations to bring a solution acceptable to us which the opponent will abide by, too. We weren't very successful in doing this in Korea; and we haven't been very successful in Vietnam. We were fairly successful in the Cuban situation, and you can find other examples. I think we need to get some better understanding of how we can use military forces, either conventional or nuclear, to achieve the ends of the political decision-maker. If we once have that information, then I would suggest that we in both the conventional and nuclear weapons community can, with our military colleagues, set out to produce the military forces that we need.

VAN CLEAVE: If that is directed to me, I can only agree, but I have no solutions for it. I have never been a fan of the graduated deterrents or the condign response type of strategy, and I think the first order of business is to try and work out something that combines conventional and tactical nuclear weapons in a useful and effective military force, because I don't believe that we are really going to see the end of the commitment of American military forces, even to Southeast Asia, much less to Northern Asia.

GIRARD (RAC): Some people here have indicated a general agreement that in Europe, at least, it would be a great idea to attempt to get some superiority in the other nuclear capabilities, and give the NATO Allies some credible assurance and some motivation for helping themselves. That's fine. On the other hand, the Russians have legitimate interest in the European question also. This gets us down to the question of how the Russian is going to react to a massive increase in the other nuclear capability, perhaps making use of the territory of West Germany as a point of origin. I'll only say that, in addition to having a general legitimate interest in Europe, the Russians have a unique body of historical experience in this century that would make almost any nation extremely jumpy about such a development. Perhaps the solution is to deploy on the flanks. On the other hand, the situation of the Seventh Army in the center region makes at least a significant slice of deployment in the center an attractive plan. I wonder if some of the panelists want to respond to that?

HOSMER: There is one point on which I think you have to disagree with Dr. Wheelon. When he said, "The Russians don't want to trigger things up now," I asked, "What about tomorrow?" They are very pragmatic about the current situation—they are having trouble over on the east, and they want to keep things quiet on the European side in case they have to draw some divisions over to the eastern side. So we have an ideal period in which we can flow this stuff in, because they can't do too much about it. Nor do I think that even without that irritant on their other border would they be inclined to go into a preemption just because we built up these forces. That is my view. I do want to emphasize the idea that, so long as their trouble with the Chinese lasts, we have this period during which we will have a great freedom of action.

VAN CLEAVE: I agree with that statement. I disagree with the proposition that we ought not to improve our tactical nuclear posture in Europe because the Soviet Union might somehow respond in a manner to offset that; I think this exaggerates the degree to which the Soviet Union reacts to specific things we do. They have a host of other factors that influence their policy. I think it also exaggerates somewhat the technical and economic constraints on the Soviet Union. Indeed what we have here, is a string of arguments against modernizing our tactical nuclear posture in Europe because the Soviet Union will respond somehow to offset it. We ought not to employ an ABM because the Soviet Union will react somehow to offset it. We ought not to make improvements in strategic offensive forces because the Soviet Union will somehow react to offset it. I think that is nonsense. I think we worry so much about the Soviet Union's response to our actions that we have perhaps forgotten that we ought to worry about our response to the Soviet Union's actions.

HOSMER: If you want to have another scenario to keep you awake at night, just think of the situation in the Middle East, when the Israelis finally screw together their bomb and launch it over on Cairo, and then the Egyptions come back with one that the Chinese had given to them. Now what is everybody going to do?

FOSTER (SRI): I'd like to address a question to Mr. Hosmer. Yesterday, I was commenting on the possibility of thinking through the problem well enough so that the President would have some options of predelegating, so that the request would not come up from the bottom. You commented that we could give him a list of problems and situations as long as your arm that would get us quite excited. Were you talking about the possibility of marrying these two concepts? I think we could increase the credibility of the current deterrent force posture by precisely that.

HOSMER: Is this the "gutless president" problem you are getting at?

FOSTER: No, it is just that you commented that if the President would give the word now, it would be total confusion. I said, if we thought the problem through to a point where the situation were spelled out, the President could make a selective release of a class of weapons in the face of a certain situation. Is that what you were referring to?

HOSMER: Yes, I think Bill Van Cleave essentially answered this when he said that at the present time we do have an incredible stockpile, and deliberately so, because of the desire to make the use of these weapons incredible. If we get a credible stockpile, one allowing our President to make a rational decision to use it in a limited way, yet in a way that would prove effective in the overall effort, then it is going to be easier for him to make such a decision because it is no longer an incredible act. Also, when you have, to an extent, publicized in advance that if certain things happen you are going to respond in certain discrete nuclear ways, then there is no question that he will make the decision; he has practically done so in advance. This resembles the way the Soviets and the Communists work according to doctrines. It simplifies the situation to a great extent, and it does not leave areas of doubt when the other side is tempted to make a probe that might get out of hand.

SQUIRE (LRL): I'd like to address a comment to Gen. Betts which rests on the idea that the concept of stockpile and modernizing the stockpile—which has been one of the chief concerns of this afternoon's session if not of the whole meeting—might not be all-inclusive. It is conceptually possible that we might get into a war with China, and need a number of weapons, far beyond anything that we can politically stockpile in peacetime, some, perhaps, of a type suitable for large scale production. And we might not be able to withdraw any from Europe.

BETTS: I couldn't quarrel with that thesis, although there are designs available now that one could produce in large numbers and low yields. Again it is a matter of adjusting our priorities. I don't quarrel with the thesis that it is very helpful to have designs of weapons available that you don't necessarily go ahead and produce. The same thing is true about weapon systems. We don't seem to get much support for that thesis.

AGNEW: I think it is extremely important that the people in the Army, CDC, Naval Operations, and Air Staff not be inhibited in their planning of doctrine by existing Phase III's. If they can conceive of certain doctrines that they would like to implement, but need certain hardware, they should be encouraged to formulate plans and turn to the laboratories for prototype development. If it eventually turns out to be something extremely worthwhile, they should go into production on it. I believe this sort of thinking has really been stifled during the last six or eight years. There were times when people from the laboratories made trips to the fields, saw what was going on, encouraged the people there to think of new types of weapons and new types of employment, but that sort of thing got turned off. I think this business of having to go by the existing "laundry list" is a very bad way to operate.

BETTS: I'd like to add one thought to that. There is a long, hard path within the military from the availability of a capability just proved in R&D to its actual use by the soldier in the field: it is made up of all the business of training, indoctrination, supply parts in the system, and maintenance capability in the system. In a short war, the system had better be available in numbers and distributed at the beginning. If you have the time, as we have had in Southeast Asia, you can indeed work those things into the system.

RUSSELL: I wonder how many of you have the same thought that I have—that we live in an open society and we are in competition with a closed society. The way to stay ahead is to exercise the power of thought that we have over here, thanks to our freedom, which has put a man on the moon, which has brought out and used the atomic weapon, and made many other advances. I just offer the thought that the way to stay ahead is to keep going.

AGNEW: General Betts, perhaps as a comment on your worry, and certainly bringing us face to face with reality, I would like to point out that the few times that nuclear weapons have been used, they were used by a sort of special group that went and did the job. It is not inconceivable to me that, rather than using the present technique of all soldiers knowing how to clean a gun, and all essentially knowing how to fire an atomic weapon, perhaps for new systems and new concepts we should do what Harry Kinard did, and train a small outfit—call it a special strike command or special airborne outfit, special company, brigade, division, or whatever is required. If you consider a limited concept like this, perhaps some of the technology which may become available can be put in the field a lot quicker than if you go through the normal 20 year army cycle.

BETTS: I think that is exactly right, and that is what the DCPG did with the sensor picture—they structured a special force. As that same collection of sensors is now made available in larger numbers, we find a real difference in how they are used among the many divisions in Vietnam , because they have had no chance to become indoctrinated, become trained in all of the maintenance aspects, put supplies in the channel, learn the concept of operations and everything that goes with it. I fully agree that it is possible to do these things on a specialized basis. I was stating the fact that you have to have some things in being if it is going to be a short war. You can't count on suddenly producing them and having the capability just because they come out at the end of a production line.

WHEELON: Some of us would say that is what is wrong with DCPG—no adequate training or provisions for the operation. The other thing is, I am not sure it is a bad thing to have DCPG sensors in the hands of untrained or at least unindoctrinated divisions, because I think by their experimentation they will find better ways to use them than we physicists could imagine when we were doing the technology part.

COTTER (SLA): I would like to comment on the modernization of the stockpile in terms of improving it qualitatively rather than quantitatively. Certainly there may be a need for more of a certain kind of weapon. And I am sure the JCS figures, which don't agree with some of the OSD figures on what is needed in the way of nuclear weapons, reflect the concern for attrition of some of these weapons during either a conventional engagement in Europe or in a tactical nuclear engagement. However, I think maybe the most important thing we could do right off is to make at least two qualitative improvements. One is in the mobility of the weapons—and people can talk about either long or short range mobile missiles, or certainly about the aircraft putting them into a V/STOL mode and allowing the possibility of dispersing fewer aircraft but still having greater survivability of a significant force. The other is a question of immediately trying to seize upon the opportunities in accurate low yield weapons, and here I think the name of the game is trying to measure targets destroyed with minimum collateral damage versus the weapons you might have that are inaccurate and have high collateral damage. One could also improve qualitatively, perhaps by reducing the number of weapons that we have in Europe to save money. The cost of the weapons, I think, is minor when compared with the cost of deployment and the specialized people who are associated with nuclear weapons.

I'd like to come back to the question of accurate low yield weapons. There were proposals for weapons that could give you a 50 foot CEP or hitting accuracy, but they require an aircraft, for example, to fly over the target or in very close proximity to it. Even the Walleye standoff range is only going to be about 10,000 feet or even less. With Bayonet and Becket weapons, where you fly over the target, you measure in terms of targets destroyed, and I think you get a little different view.

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DELETED In either case, no matter how you employ these weapons, it requires the airplane to fly over the target. In some cases this will be higher than 300 feet. Even in the so-called LAD pop-up maneuver, the man goes over the target at about 2500 feet. So we essentially have no capability in air delivered ordnance at the moment, because of the fact that you do have to fly over the target. That is very serious and if, indeed, the AGMX3 missile is such a good thing, I think it is tragic that it has been postponed for a year or two because of some cut in the Defense Department budget. Perhaps the allocation of R&D money or development money has to be looked at again to get us out of this situation.

AGNEW: I am glad Mr. Cotter brought up collateral damage, because when you realize that we have used over two million tons of conventional ordnance delivered by air and over five million tons of conventional ordnance delivered by ground forces in South Vietnam, I find it a little hard to sympathize with the obsession with collateral damage. It seems to be all right to have collateral damage with conventional weapons but it is a "no-no" for nuclear weapons.

MALIK (LASL): My group looks at the feasibility of doing nuclear tests as part of the readiness program—operational system tests and troop tests. We continue to be appalled at how difficult it is to do this kind of thing under peacetime safety rules. Some of these problems should be faced by an operational system as it is being developed. Most of our problems have to do with things like fallout, retinal burn, system malfunction and—the thing which General Betts brought up—political problems and public acceptance. Some of these will go away in time of war, presumably, but one worries about how the public, particularly the Germans, will react to a nuclear war versus a conventional war, given a chance that they might possibly win a conventional war. In Nevada we can only fire 2 kt, presumably, under existing rules—that is, with no safety factors. It seems to me that there ought to be an evaluation of the overall system in somewhat greater depth than is being done at the present time. I have heard no mention at all of the retinal burn problem. Such things as long term fallout problems perhaps should be addressed by developers of the system.

DOUGHERTY (LASL): I have a couple of observations on the subject of nuclear artillery. If I remember correctly, Dr. Ord stated that there is no doubt that the Russians are capable of building nuclear artillery, but there is no evidence that they have done it. I don't know what the chances are of their doing something that we don't have any evidence of, but I would hate to jump to the conclusion that they don't in fact have nuclear artillery. On the other hand, we worry when we are losing nuclear superiority in certain areas, and yet if they don't have nuclear artillery, here is one place that we have nuclear superiority, and we are worrying about that, too.

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